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A STEP IN ADVANCE.

ONE of the great questions of the day which has seriously engaged the attention of electricians for several years past appears to be very near its solution, at all events, near enough to come within the realms of practicability and commercial success. We refer to the matter of electrical traction by means of accumulators, which is, after all, the most rational method of going to work on existing tramlines, assuming that the secondary batteries may be depended upon for durability, and that they are constructed to give out the maximum of work with a minimum of weight. We cannot shut our eyes to the fact that desirable as it is to be able to compete with horse traction by means of the storage method, no really successful plan of doing this has yet been forthcoming from the commercial standpoint, nor have any batteries stood the necessary test of time. It is, therefore, more than probable that we must look to a material other than lead for the construction of secondary battery plates, and a very promising attempt in this direction has been made by Messrs. Commelin and Desmazures.

Instead of using lead and acid the elements of their accumulator are pure porous copper plates, tinned iron plates and an alkaline liquid, and the principal point in the invention appears to lie in the peculiar method of constructing these porous copper plates.

A very heavy discharge is said to be obtained without either injury to its durability or practical loss of electromotive force. Owing to the chemical action which takes place during the discharge, the internal resistance *decreases* as the rate of discharge *increases*. To do the same work as the Elieson cells on the North Metropolitan Tramway system, the weight of the elements can be reduced to about one-third of those modified Plantè batteries. No acid is employed, no lead plates with dropping active material are necessary, no leakage of boxes takes place, the cells being made of ordinary sheet iron, and supervision is said to be quite superfluous, not even the addition of water being required. With these advantages, it seems evident that there is a big future for the Commelin-Desmazures invention, especially as one of our leading authorities on this subject has given it as his deliberate opinion that it opens up quite a new field in the transmission of power by electricity. The gentleman to whom we refer, Mr. J. Bedford Elwell, has experimented with the apparatus, and he considers that by means of it the problem of electric traction by secondary batteries is solved; in fact, that this is the only accumulator suitable for the purpose. The well known Captain Krebs, the expert and adviser in electrical matters to the French Government, also expresses his firm belief that it is superior to anything hitherto produced.

The average length of each street car line in Paris worked by the Société Générale des Omnibus, the only company which gives annually an exact *resumé* of its working results and expenses, is about 6,000 metres; each carriage makes an average of eight turns, equivalent to a distance of 96 kilometres per day. For the daily traction of each car 13 horses at £48 each are required, making a total of £624 per car, whereas Messrs. Commelin and Desmazures estimate that an outlay of £360 would cover all the electrical plant necessary to perform the same work as that done by the horses. In a comparative table of working expenses per car and per day they claim a saving of 48 per cent.

Curiously enough this battery does not seem to be advocated for electric lighting purpcses with the one exception of miners' safety lamps, for which the Commelin-Desmazures combination is claimed to be unrivalled in all respects. Sufficient information concerning the superfine qualities of this battery has reached us to make us desirous of securing further particulars of its practical employment, and we should esteem it a favour if any of our readers can assist us either directly or indirectly in attaining this end.

At present we are limited to one type of accumulator, slightly varying in form and construction perhaps, but alike in principle, and any addition to this branch of the electrical industry would be welcomed on all sides, and if the reports of its superiority over all others can be maintained and the price is not against it, there should be no difficulty in introducing it into this country on a very large scale.

A SIGN OF THE TIMES.

THE progress which is being effected by Electric Light Companies in every part of the country becomes more marked every day. Even in the South of England, where with a few exceptions the gas monopoly has not been seriously shaken, there are signs of a great advance in the near future.

Eastbourne affords an example which might well be followed by many larger towns along the coast, more particularly by Portsmouth, where although two or three tradesmen have adopted electricity for lighting purposes on their own initiative, and a palatial town hall is now in course of erection at a cost of close upon £100,000, deserving of something better than gas illumination, there is no local company to offer the advantages which have proved so valuable in other places. Gas companies are generally remarkably well represented on the different public boards, and hence the unwillingness of the latter as a rule to entertain the question of improved lighting. It is satisfactory to note, however, in spite of the obstacles which an old-established and thriving monopoly is always enabled to put in the way of a comparatively struggling rival, the electric lighting movement is going ahead in a manner which can leave little doubt as to what its position will be a decade or so hence. At Eastbourne

the progress, as the Mayor stated at the annual meeting a few days since of the local electric light company, has been slow but sure; there are now 1,700 lights distributed over the town, in spite of the efforts of the gas directors and others who have flooded the local Press with letters antagonistic to electric lighting. At the present time the gas company pays 12½ per cent., and with the prospect of considerably reduced dividends in the future, the shareholders may readily be forgiven for any little ebullitions of temper which they may display in regard to their rival. The electric light company has for six years had a hard uphill fight, having started with insufficient capital, but, thanks to the astuteness of the directors, there is now a promising future before the enterprise.

WE were good naturedly taken to task a few weeks ago for mercilessly running down untried inventions, and we defended ourselves—successfully, we think—from such an impeachment. When an invention has been tried and found successful, or the reverse, comments are of little value, and we do not care to be classed amongst those who await results and then call out, "I told you how it would be." We take it, then, to be the duty of journalists to do everything in their power, by criticism, to indicate, so far as human judgment is capable of showing, the merits or demerits of any new thing which comes before the public. The old adage of the futility of locking the stable door after the steed has vanished applies just as forcibly to matters with which we deal, as in the more commonplace phases of life, and we now desire to call attention to a little incident in the hope that some information of a practical and reliable nature may be elicited.

MR. FERRANTI has designed a main cable for the Deptford Central Station installation, formed by two concentric metal tubes insulated from each other, and manufactured in lengths of 20 feet. The current through these bare conductors, for they are perfectly bare, and separated only by the thickness of the dielectric, will flow under a pressure of 10,000 volts. The insulation is spoken of in a contemporary as costing but a few pence per pound, and laboratory tests have been made with a sheet of ebonite and an induction coil, tests which, old enough in themselves, appear to lead Mr. Ferranti to the belief that his cable will be infallible. Will the insulating compound bear the rigour of an English winter without cracking, or a summer's heat without becoming unduly soft? Has any allowance been made for the effects of expansion and contraction of the copper tubes from extremes of heat and cold? Has even a length of the proposed conductor been experimented upon under a high voltage? for we find no indication of such a test. We might go on with quite a number of questions, but those enumerated are of vital importance, and we trust they have been fully considered, or the consequences may be disastrous to the directors of the London Electric Supply Company, notwithstanding the confidence they repose in their engineer, who seems to be quite an Admirable Crichton.

DURING the American Exhibition we published, for the first time we believe in this country, an illustrated description of Waring's cables. Since then but little has apparently been done with these underground conductors in England, although specimen lengths varying from a mile downwards have been laid. We believe there is now, however, the probability of their introduction into this country on a large scale, a factory for their manufacture down the river being spoken of as decided upon. Prof. Forbes has written favourably of them, from his American experience we suppose, and Sir William Thomson states that as a general conclusion from the extensive and searching tests of the Waring cables which he has made in his laboratory since the first specimens were sent to him, he is of opinion that they are well suited for all underground telegraphic and telephonic work and for underground electric light conductors; also for conductors carried through buildings or tunnels and in close proximity to large steam pipes, or along walls out of doors in a great variety of circumstances. The insulating materials and the mode of their application are such, that however high their temperature, the conductor can never become displaced from its proper position in the axis of the containing tube. It may be heated up to anything under the melting temperature of lead, and kept hot without permanent damage. The insulation, as in the case of all other known insulating material, is greatly diminished by elevation of temperature, but, unlike others, its usefulness as an insulator is not destroyed by high temperatures, and when brought back to any ordinary condition of temperature, it returns fully to its normal insulating value, without deterioration of any kind. Further particulars respecting these leads can be seen by referring to the ELECTRICAL REVIEW for August 5th, 1887, but with such references as those above quoted, there should be every chance of Waring's cables successfully competing with others on this side.

AFTER the discussion which took place at the general meeting of the Electrical Trades Section of the London Chamber of Commerce it was only to be expected that a diversity of opinion should exist amongst those interested, not only with reference to the business to be transacted, but also with the composition of the working committee. The letter which we publish in our correspondence columns tends to indicate the attitude which is likely to be taken up, but the writer has evidently misunderstood the scope of the section. Either the whole of the electrical trades must be represented or the section must be limited to some special department. If the former is the case then it must be conceded that telegraphy represents at the present moment the most important branch of all the electrical industries. Again, electricity supply companies are likely to increase very materially during the next 12 months, but we can scarcely think it likely that contractors and manufacturers will add to their numbers in any marked degree. Nevertheless, there is much in the communication with which Mr. Verity has favoured us worthy of consideration, which will doubtlessly be fully dealt with at next Monday's meeting.

THE first number of a new journal, a really sweet thing in its way, entitled *Sugar*, has reached us. A well-written article, "Sugar Refining by Electricity Critically Examined," by Mr. T. L. Patterson, F.I.C., F.C.S., is well-timed, and should do much towards reassuring those gullible people who are always ready to believe that any process to which the mystic name of electricity is allied will assuredly revolutionise every-

thing else which has proved itself eminently satisfactory and stood the test of time. Mr. Patterson shows conclusively that the wonderful results accredited to electricity, aided by secret machinery and mysterious demonstrations of the "Keeley" motor kind, cannot possibly obtain, and the only conclusion to which any sensible being can arrive after the perusal of this very interesting and eminently practical paper, filled as it is with reliable figures, is that the whole thing is a fraud. We trust that our contemporary will continue as it has commenced, by fearlessly exposing anything in its special domain which will not bear the criticism of scientific investigation.

A COMMUNICATION which we have received from Mr. F. H. Webb, the courteous secretary of the Society of Telegraph-Engineers and Electricians, contains information which is as surprising as it is satisfactory. The familiar but extremely awkward name of the Society is, as our readers know, to undergo a radical change, and the Society will in the future be known as the Institute of Electrical Engineers. We had no doubt whatever but that the change would be entirely acceptable to a large majority of the members, but we never dreamed that there would be such rare unanimity as has actually been displayed. A circular was issued to members of all classes requesting their opinion upon the contemplated change of name, and to this circular 846 replies were received. No less than 837 expressed approval of the change of title, the remaining nine disapproving. We trust that in future questions of importance there will be as little division of opinion, where division may mean a weakening of power to do good.

THE *Financial Times* makes some very strong comments upon the modern progress of electric lighting, and likens recent schemes to some of the notorious attempts—attempts too often successful—to extract money from investors' pockets in the electric lighting craze of 1881 and 1882. Much of what our contemporary says is no doubt justified, and it recalls many facts which it is useful to remember. It gets a little off the track, however, occasionally, and makes statements for which it scarcely has warrant. The Gülcher Electric Light and Power Company will scarcely admit, probably, that it has retired into obscurity, nor the Edison-Swan Company that all the steam has been taken out of it by recent legal decisions; true it exists "in a sort of way," as the *Financial Times* says, but it must be a very good sort of way to enable it to show a profit on the year's working of £25,000. The Pilsen-Joel Company did not go down in the storm of 1882, though it took in all sail, and it cannot certainly be said that it has gone down even now. With some other remarks made by our financial contemporary, however, we are in agreement, notably when it says: "We do not wish to see the same cruel farce played over again—that is, the promotion of companies to buy worthless concessions at ridiculous prices, which, while hampering the purchasers, confer no lasting good on the company, but inflict enormous injury on the industry, and only serve to bring disaster and obloquy upon everybody concerned."

To those who have designed or are advocating new types of electrical conductors, for either underground or overhead purposes, we cordially commend the perusal of Dr. Wheeler's paper, which may be found in our other pages. This is one of the most practical articles of its kind we have ever come across, and it should be read by all electricians, and although some weeks ago we gave a somewhat lengthy extract, a friend, whose opinion we value very much, and who on this side knows as much about electrical conductors as any man living, thinks so highly of the manner in which the subject is dealt with that we have reproduced it in full. Writing from abroad, he says:—"The most sensible paper I have seen for a long time on underground wires is that by Dr. S. Wheeler, which was read before the National Electric Light Convention in New York. I think it should be better known, as there is not too much verbiage, and the results of the experiments and the conclusions drawn are very good indeed."

WE hear on good authority that the Crossley gas engines which have been working for some time in the Post Office Savings Bank in Knightrider Street, City, are to be displaced in favour of Willans's and Robinson's steam engines. It would be interesting to know the reasons which have led to the abandonment of these very celebrated engines.

THE information in the first part of Mr. Preece's letter in this issue is of great novelty and importance. Up to now the Post Office wire runners have used the most refractory solder obtainable. They made the joint first, and then attached the wires to it on each side. The difficulty in doing this led to an exorbitant expenditure of postage stamp edging as a makeshift. Next week, perhaps, we shall be favoured with something like the following: "A new method of enabling one's respected (except in the writer's case) ancestor to exhaust the albumen from the calcareous spheroid of the *gallus domesticus*. The method of procedure which has been followed is, first to purchase two small apertures of convenient magnitude. These are gimbled or screwed into the points of intersection of the major axis and the exterior surface. The great question now arises whether the exhaustion is to be effected from the interior of the ellipsoid, or from the external region; and this it has been my endeavour, with the help of my gardener, to determine. Though Hertz has shown that the first ought to be possible, difficulty arises in the preliminary insertion of one's grandmother, and I therefore beg to burst upon the astounded universe with the information than an egg should be sucked from the outside."

Mr. MASSINGHAM has achieved a great victory in Bath, for he has succeeded in converting his opponents. Alderman Gibbs, who moved the adoption of the report of the electric lighting committee (given in another column), at the recent meeting of the Town Council, was vigorously antagonistic to the scheme when it was first mooted, and several other councillors who recorded their agreement with the report were formerly opposed to the innovation. The *Bath Journal*, the only one of the Bath papers which did not at first support the proposal for the introduction of the electric light, now, if not positively favourable to the scheme, at any rate speaks very appreciatively both of the work of the electric lighting committee and of the efforts of Mr. Massingham. The latter and his friends are hopeful of making the electric light even more popular at Bath than it is at Taunton. We hope the pioneers of the light in the West will reap their due reward.

ATMOSPHERIC ELECTRICITY.

As far back as 1850 the author (M. L. Palmieri, in *La Lumière Electrique*) demonstrated that on exposing to the open air an insulated metallic vessel filled with water which can escape by one or several pipes into another metal vessel also insulated and placed at a level 2 or 3 metres below the former, we see the first vessel give decided indications of positive electricity whilst the water is escaping. This electricity, the presence of which is observed at the beginning of the stream, disappears further and then reappears, but in a negative state, augmenting in intensity as we approach the ground. If it is collected in the lower vessel it is found negative. If the upper vessel is not insulated we have merely negative electricity in the descending stream.

If the electricity of the air is negative the phenomena will be inverse; the upper vessel will indicate negative electricity and the lower positive. Fig. 1 shows the arrangements for these experiments.

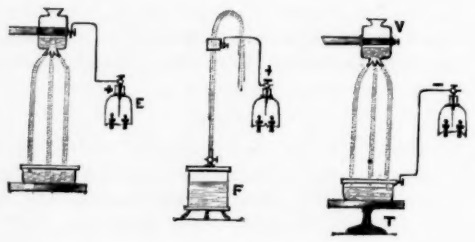

FIG. 1.

If instead of using a liquid we take granules of lead, metallic powder or even volcanic ashes, the phenomena are identical.

Vesuvius has often given occasion to observe that the falling ashes are charged with negative electricity, but if the ascending smoke is very dense it renders it difficult to distinguish the negative electricity of the ashes. Hence sometimes the ashes falling upon the collecting disc appear negative if the instrument is kept motionless, but if the condenser is rapidly raised positive electricity is observed induced by the smoke which exists above.

The sands of deserts and even the dust of roads when falling show negative electricity. These facts come under the general law, that when a conductor is raised it shows in ordinary weather positive electricity, but when it is lowered negative electricity.

If negative electricity predominates in the air the law is inverted. From the experiments described above we are forced to conclude that water, by the mere fact of its falling, assumes negative electricity.

After this fundamental observation it was natural to suspect that rain, hail and snow ought in general to acquire negative electricity or, in general, electricity opposite to that of the air above. But on observation it was found that where rain is falling we have nearly always a strong positive electricity derived from the influence of the cloud which, as it resolves itself into rain, becomes an abundant source of positive electricity, so that the negative electricity of the rain may remain masked.

When falls of snow occur at the Observatory on Vesuvius the author has frequently observed negative electricity, especially when innumerable flakes driven by the wind and floating in the air fell outside the region in which they had been formed.

Sometimes, beneath rain there is negative electricity, but this is derived from another shower falling at a distance such that the place of observation is included in the zone of negative electricity which always surrounds a region of rain according to the law which the author discovered in 1854.

The difficulty of rendering manifest the negative electricity which rain must acquire in its fall springs precisely from the abundance of positive electricity developed by the clouds which are being resolved into water. If the upper vessel (fig. 1) which was in a neutral state becomes positively electrised when the liquid descends, it is plain that if it had been charged with positive electricity this would have increased during the fall of the water.

Hence it is that rain, hail and snow which must by the mere fact of their descent assume negative electricity increase the positive electricity of the cloud above and give rise to thunder, which is never produced without abundant rainfall.

The lightnings which in severe volcanic eruptions flash through the smoke rising from the crater seem to form an exception to this rule, but an abundant shower of ashes is a necessary condition for such lightning. Thus we may have great eruptions without lightning, and inversely. This is proved not merely by personal observations but by the figures and records of all the eruptions of Vesuvius. The small volcanic island which entered in eruption in August, emitting dense smoke with abundance of sand, has repeatedly presented the spectacle of lightning. But why is it so easy to see the negative electricity which a thin liquid stream acquires when falling a height of two or three metres from a metal vessel which, if insulated, acquires positive electricity, and so difficult to observe the negative electricity which atmospheric water must acquire when falling from the clouds above? The author suspects that this is due to the abundant positive electricity developed by the condensation of vapour. To have an experimental proof he electrified positively the upper insulated vessel, whilst the descending stream gave negative electricity to the latter vessel. At once he saw this negative electricity diminish and then disappear in consequence of the charge given to the upper vessel.

The very powerful electricity collected in rain, even when not storm rain, is in itself proof positive that a cloud when resolving itself into water becomes a plentiful source of positive electricity.

Certain grave errors on this question have occurred in an elementary treatise on electricity and magnetism lately published in France. Speaking of the origin of atmospheric electricity, the author says: "A seductive hypothesis sees in the evaporation of water the source of electricity. The vapour carries off the positive electricity, whilst the water and the earth retain the negative electricity. Unfortunately, no experiment undertaken to demonstrate this view has given decisive results." He further adds: "the fact that rain is generally negative seems in direct contradiction to the hypothesis."

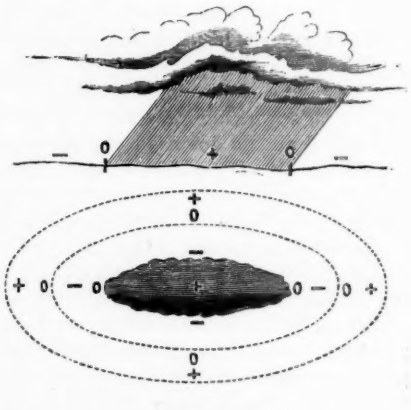

FIG. 2.

If by negative rain the author means that in which the apparatus employed gives manifestations of negative electricity, he errs greatly, considering that under rain (fig. 2) we have generally a very strong positive electricity, and we now know how we may exceptionally have

negative electricity under rain without derogating from the law of the development of electricity by the condensation of vapour, especially when it is converted into rain or snow.

If, on the other hand, by the negative electricity of rain we are to understand that which rain acquires by the fact of its descent, this being negative is the most striking proof of the predominance of positive electricity.

He says elsewhere, still recognising that the potential of the air is ordinarily positive: "In cloudy weather, especially in rain, and on rare exceptions under a clear sky, the potential of the air is negative and that of the ground positive."

The author, on the contrary, mentions that the potential of the air, whether the sky is clear or cloudy, is always positive unless rain, hail or snow is falling within a certain distance, or there are showers of sand ejected by a volcano or carried up by the wind.

And since then when rain is falling we have strong positive electricity with a narrow surrounding zone of intense negative electricity which begins with the rain, lasts and travels with it and disappears with it, it is certain that at a certain distance, which may be from 60 to 70 kilometres according to the author's observations, there is a cloud which is being resolved into rain or snow.

If this zone is very extensive, as it habitually occurs in heavy or stormy downfall, the observer may happen to be in this zone with the heavens perfectly serene over all his horizon, and if within this zone there are clouds resolving themselves into slighter rain below, the observer will find negative electricity persisting after the cessation of what we may call the secondary rains, and this because the negative electricity is not derived from the rain originating in the negative zone of the primary rain. This is the summary of the long period of experiments conducted on Vesuvius at 637 metres above the sea level.

These facts having been demonstrated by direct experiment with suitable apparatus, and under peculiarly favourable conditions, the author continues to maintain them in opposition to the assertions met with in certain works.

The phenomena of the liquid current descending, which the author studied in 1850, induced him to indicate a new method for the ordinary observations of electric meteorology; but he does not find it preferable to the method of the movable conductor to which he adheres. Nevertheless, under peculiar conditions, he employs a water collector.

Sir W. Thomson, wishing to register the phenomena without the presence of an observer, made use of the above-mentioned collector and of an heterostatic electrometer which has been improved by M. Mascart. In consequence of the continued variations of atmospheric electricity from moment to moment, the use of a registering apparatus with continuous indications seems opportune.

At the Meteorological Congress of Rome the author proved that the curves obtained cannot have a truly scientific meaning unless we know the errors of dispersion, and M. Mascart admits that with the author's apparatus it is possible to verify the results furnished by the others. Without too much insisting on this point he wishes observers to be penetrated with the idea that in meteorology registering appliances are generally subsidiary to the instruments of direct observation.

In the study of atmospheric electricity direct observations are of capital importance, for if with each electric variation which we perceive we consider analytically the aspect of the heavens, we may determine the cause from which this variation proceeds. Whatever may be the sensitiveness and precision of a registering instrument, unless it is seconded by the observer, it will never indicate all that an experienced eye will detect and scrutinise.

Thus, for instance, we may observe negative electricity and have before us a vast horizon; we see easily rain falling at a certain distance, and we find the negative electricity rapidly disappearing if the rain ceases. The apparatus will indicate only a part of this, and the incomplete observation will prove nothing. If we admit that the curves are free from error, they will give the history of the facts but not the key, the cause of the variations of atmospheric electricity.

The registering instruments, costly, complicated, and requiring assiduous care, cannot be readily admitted into every observatory, and it is not by their means that we can discover the true laws of atmospheric electricity. We may rationally use them as auxiliaries where the conditions permit, but it is necessary that we calculate beforehand the value of the direct observations which may one day serve to interpret, and perhaps even to correct, the graphic curves.

NOTES FROM BRITISH GUIANA.

EARLY in August last the cable connecting the Island of Wakenaam with the mainland of Essequibo County failed. On going down to test it Mr. Vyle carried a pair of Bell hand telephones with him, and though the insulation was as low as 600 ohms, keying and speaking into the telephone with the cable connected as a separate circuit was a success. With a single cell of Leclanché at either side work was got off every half hour, the other given up to testing. In this way a boat's hire was saved over the four and half miles of distance, and the messages suffered but very little delay. So novel a telegraph station has probably rarely been seen as this, where an open box 4 by 4 by 1 foot nailed to the terminal pole, so close to the water that the clerk, a black youth, stood at spring tide in nearly a foot of tidal water and spoke his message into the telephone. A punt was hired, and apparatus and spare cable provided, and started for the scene of work, taking, however, nearly 60 hours to get there. Two days' actual work enabled the electrician to cut out several faults and report the cable as quite clear, and ordinary message work was resumed.

The services of Mr. Vyle, the Government electrician, have been in request lately by the planters of the Colony of British Guiana. He has been *loaned* several times, and his practical acquaintance with electric lighting has stood him in good stead for the planters. In one case a Brush "Victoria" machine was sent out by that company and was run, but no current could be got from her. A gentleman was called to it by telegram from Georgetown, but still it refused current, and it was reported that the Belvedere Road firm had sent out "a motor" by mistake. Mr. Vyle's task was the simple removal with a file of an excess of black dirt on the ends connecting the inside wires with the outside.

Electric lighting is advancing in favour with the the Demerara planters, and there is a wholesome rivalry amongst them regarding it. There are no less than four of the Brush series arc lamp installations, one or two worked by the Gramme, and two or three recently imported Victorias, with arc and incandescents combined. There is also a Paterson and Cooper plant just put up which is giving great satisfaction.

The Demerara Telephone Exchange is to be benefitted on the plan of the Irishman's gun. Pat only got a new lock, stock and barrel, and Mr. Vyle has fought for and got permission to erect new poles and wires (copper) to replace No. 16 iron wire with dry joints, and the Ader telephone with the Bell and Blake, and to fix a "Standard" exchange board for the present one. When these changes are made Demerara should have one of the best, if not the very best, telephone exchange in the West Indies.

Mr. Vyle is to deliver the next popular lecture before the Royal Agricultural and Commercial Society, Georgetown, on the 16th November. The title is "Electricity at Work." If Mr. Preece's pupil has any of his former chief's verve about him, his audience should be both informed and interested.

A PRACTICAL CONCEPTION OF THE ELECTRIC FIELD.

By JOHN GRAY, B.Sc.

PART II.

LET us now consider what will take place if we place an insulated electric conductor in an electrically strained dielectric. We will assume in the first place that the conductor is cylindrical in shape, and that its axis is placed in the direction of the lines of force. We will also assume that the lines of force are parallel, and the conductor is of such a length as to annihilate one-half the number of elastic diaphragms between the poles (*i.e.*, the terminal conducting surfaces) of the electric field. Fig. 4 is a diagrammatic representation of such

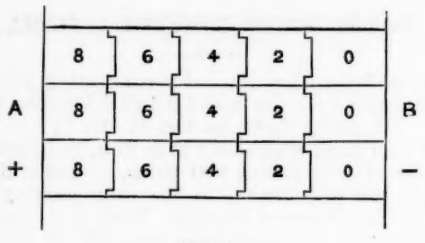

FIG. 4.

a field as we have been describing, before the conductor has been introduced. A is the positive pole of the field at a potential represented by 8, B the negative pole, assumed to be at zero potential. The potential is assumed to fall uniformly; the figures in each cell representing the potential in that cell, and the stretch on the diaphragms the E.M.F. Fig. 5 represents the con-

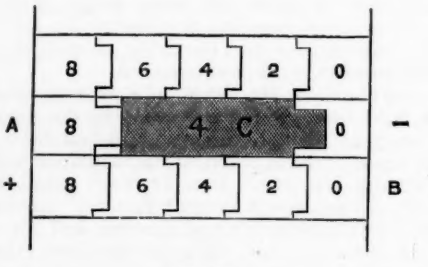

FIG 5.

dition of the same field when a conductor, C, is introduced into the middle tube of force, so as to annihilate two of the diaphragms. As two diaphragms instead of four have now to sustain the whole difference of potential, they will be stretched to double the extent. The potential of the conductor it will be observed is now four. Let us compare its potential with that of the surrounding field. At the end nearest A (the positively electrified pole), it is lower than the surrounding field, and therefore will exhibit negative electrification; at the end farthest from A it is higher than the surrounding field, and therefore will exhibit positive electrification. We have here the explanation of the well-known phenomena of *electric influence*, or, as it is sometimes called, *electrostatic induction*. It is often erroneously stated in text-books of electricity that under the influence of an electrified conductor a separation of the electricity or electricities in a neutral conductor takes place. It will be obvious, if the above explanation is correct, that no such separation takes place. The potential throughout the conductor is the same, the difference or separation, so called, is in the dielectric which surrounds it. Another diagram may be given which will exhibit more accurately the condition of the electric field.

Let O X (fig. 6), represent a line of force drawn between the two poles, A and B (see fig. 5) of the electric field; O Y drawn at right angles to O X represents the potential of the plate, A; the potential of the other pole, B, being zero. A straight line, Y X, is the diagram of potential between the two poles; the potential at X_1, for example, is represented by X_1, Y_1. The diagram of potential in the tube of force containing the conductor, *c*, is Y B C X, the part, B C, in the conductor being parallel to O X. If a pair of pith balls were suspended from the end, B, of the conductor, they will take the potential of B. The potential of the field unaffected by the conductor will be greater than that of B, by an amount represented by the line, B D; therefore the pith balls will diverge as if charged with negative electricity of a potential equal to B D. In the same way, pith balls suspended at C will diverge with positive electricity of a potential represented by C E. In fact, the so-called separation of the electricities under *influence* will appear to have taken place. Positive and negative electrification is simply positive or negative electromotive force with reference to the surrounding field.

Discharging Effect of Points.

The diagram of potential, fig. 6, is for parallel tubes of force, *i.e.*, for a field where the decrease of potential is uniform, and Y X is therefore a straight line; the

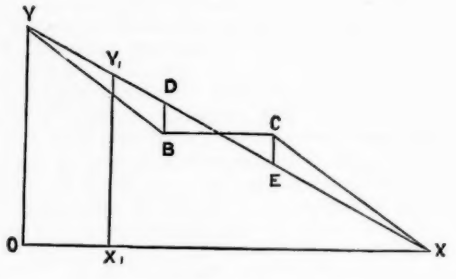

FIG. 6.

line Y X B, however, will usually be a curve. Take the case of a conical tube of force (fig. 7), where a point forms one pole of the electric field, and a plane or spherical surface the other pole. Owing to the smaller area of the elastic diaphragms near the apex the distortion will be proportionally greater, as the same quantity of electricity has to be displaced at each diaphragm.

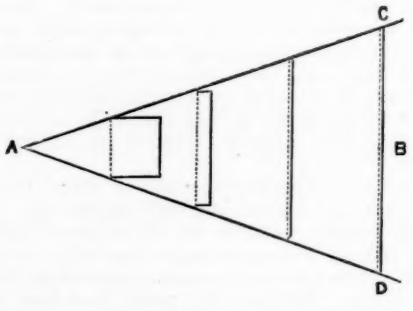

FIG. 7.

Fig. 7 roughly indicates the distortion of diaphragms at different distances. It can be easily seen that the distortion of the diaphragm will be inversely proportional to the square of its distance from the apex, A, of the cone, the areas being proportional to the square of their distances from the apex. The curve of potential, F B, will in this case be a rectangular hyperbola (fig. 8) (as we shall demonstrate further on), and, if the apex of the cone be a mathematical point, the E.M.F. at A will be infinite. This explains *the discharging effect of points* on a conductor, for the diaphragms of the dielectric will burst if the distortion, *i.e.*, the E.M.F., exceeds

a certain limit, and the electricity flows away from the conductor in the form of the well-known *Brush discharge.*

Equation of Potential.

The equation for determining the potential due to an electrified point at any given distance from the electrified point may be deduced from the curve or diagram

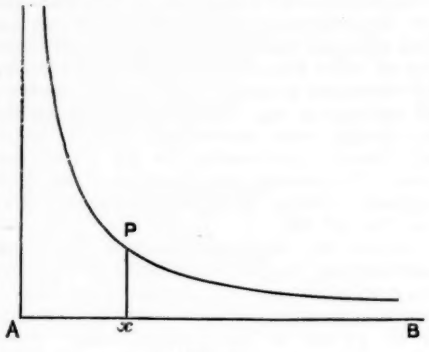

FIG. 8.

of potential shown at fig. 8. Let P be the given point at a distance, A x, from the electrified point. The potential at P is P x. By a well-known property of the hyperbola P $x \times$ A x = constant, therefore P x = potential at P = $\frac{\text{constant}}{\text{A } x}$, *i.e., the potential at any point is inversely proportional to its distance from the electrified point.*

Attraction and Repulsion.

Under certain circumstances it is found by experiment that certain bodies are attracted or repelled by electrified conductors. We will now attempt some explanation of this phenomenon in terms of the elastic cell theory. We will first consider the case of a neutral conductor placed in an electric field in which there is a uniform E.M.F., such a field, for instance, as will be produced between two parallel plates of large size, one of which has a positive charge, and the other is connected to the earth. Fig. 5 shows a diagrammatic section of such a field, the positive pole plate, A, is charged to a potential of, say, eight; the negative pole plate, B, is supposed to be connected to the earth, and is, therefore, at zero-potential. The E.M.F., or stretching force, on the diaphragms is two. Three tubes of force are shown; a conductor, C, being placed in the central tube. This conducting body, as we have previously explained, imparts its conducting property to two diaphragms, thereby increasing the E.M.F., or stretch, on the diaphragms in the central tube.

In this theory it is necessary to assume that diaphragms, when just outside the conducting substance of the conductor, adhere to it as a schoolboy's sucker adheres to the wet stone on which it is pressed. We will suppose the conductor to be advancing towards A. The diaphragm in front of the conductor is under tension, and when it is perforated, or becomes conducting by its absorption into the conductor as it advances, the tension of the diaphragm pulls the body forward. At the same time the posterior end of the conductor is sealed by a diaphragm which is leaving it, but not in a stretched condition. We have thus the tension of the diaphragm representing a force of four pulling the conductor forward, and the difference of potential between the conductor and the following cell also represented by a force of four pulling it back. The resultant force acting on the conducting body will therefore be zero. From this it would appear that there will be no *electric force* on a neutral conductor placed in an electric field of uniform E.M.F. which, however, we will see is only true when the body is in the centre of the field. The law, however, may be deduced from the above theoretical explanation that the *electric force*, or mechanical push, or pull, on a body in an electric field is proportional to the difference of the E.M.Fs. at its two ends.

The assumption in the previous explanation which presents the greatest difficulty, is the adherence of the elastic diaphragms to the ends of the conducting body. It may help us to see the necessity for the assumption if we remember that as a conducting body advances and comes in contact with a stretched diaphragm it imparts its conducting property to it, the pressure on both sides of the diaphragm becomes equalised, and the diaphragm must consequently seek to return to its neutral position. It cannot in doing so leave the conducting body behind it as otherwise its pores are closed up, it becomes again non-conducting, and the difference of pressure established between its opposite sides prevents its further movement. Hence we are driven to the conclusion that it adheres to the end of the conductor, and exercises a mechanical pull upon it. Fig 9 is a diagram which gives a more accurate representation of the conductor placed in the field of uniform E.M.F. than that shown in fig. 5. O represents the position of the pole plate, A, X that of B. O Y represents the potential at O, and the potential at X is taken as zero. The straight line Y X represents the potential in the field between the two plates except in the particular tube of force in which the conductor A B is placed. The diagram for this tube is Y A B X when the conductor is in the middle of the field, Y A_1 B_1 X or Y A_2 B_2 X when A B is near one

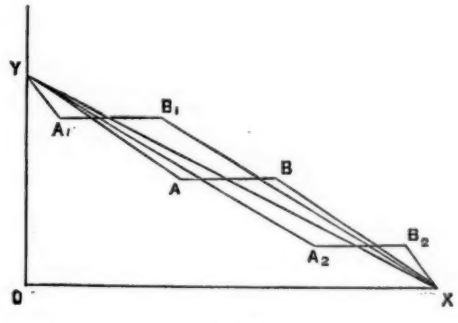

FIG. 9.

or other of the poles of the field. There is no resultant force acting upon the body A B when the conductor is placed in middle of the field, because the steepness or inclination of A Y is equal to that of B X, these inclinations representing the electromotive forces at the opposite ends of A B. When the conductor is in the position A_1 B_1, the inclination of A_1 Y is greater than that of B_1 X_1, and there will be a resultant force towards the positive pole of the field. By similar reasoning it would appear that A_2 B_2 will be attracted to the negative pole of the field.

(*To be continued.*)

MECHANICAL REGULATION OF DYNAMOS.*

By PAUL MULLER.

IN the extremely important question of regulating the tension of dynamos, it may be of interest to cite briefly the various points of view which have hitherto prevailed in this respect in order to show at the same time the line of thought which underlies the method of regulation about to be described. With the appearance of the first equal tension machines there appeared to be a conviction that the problem of regulation was finally solved. It does not fall within the scope of the present memoir to discuss the interchange of opinions on the subject to be found in the technical papers, and to weigh the pros and the cons with respect to the

* *Centralblatt für Elektrotechnik.*

utility of the so-called compound machines. If this new form of dynamo was at first somewhat over-valued its superiority as compared with pure shunt machines has, in course of time, become apparent, and each of the different types of machine has found a corresponding sphere of action.

Still, it is beyond all doubt that in practical work a regulator (rheostat) cannot be dispensed with, since even the best equal tension machines fulfil their purpose only within certain limits. Above all, the fluctuations of resistance produced by changes of temperature in the machine must be compensated by external resistances. 'I may here be permitted in the first place to bring forward some considerations in reference to the expression selected—"mechanical regulation."

The arrangements for changing the tension by the intercalation of resistances or the displacement of auxiliary brushes at the current collector serve also, like the construction about to be described, to adapt the magnetic condition of the machine to the work to be performed at the time being. But between both methods there is a certain difference in the manner of acting on the magnetism. The first method, in which we act upon the current supplying the field magnets by changing the resistance, and thereby altering the magnetism, may be called "indirect electric regulation," whilst the other method about to be examined is based upon a "direct mechanical action upon the magnetism."

After these explanations it may be briefly shown in what manner the thought of this method of regulation has been already entertained. Möhring is probably the first who has come upon arrangements of this kind. According to his statements, a circle of magnets arranged in a radiating position may be displaced towards the ring-shaped armature parallel to its axis, thus modifying the strength of the magnetic field. But as nothing further was heard of it, and as the construction is not applicable in machines with drum-shaped rings, we must pass on to the "method of mechanical regulation," already mentioned. My experiments date back to the spring of 1886. These experiments were made in the electro-technical laboratory of Professor Slaby, in connection with the Royal Technical High School at Charlottenburg.

A dynamo by Siemens and Halske, type D_{17}, with magnetic laminæ of wrought iron, capable of being easily changed, afforded convenient means of examining the influence of masses of iron in the field magnets upon the tension, and, in fact, there were found sufficient data for the following construction, although some time elapsed before it was carried into execution.

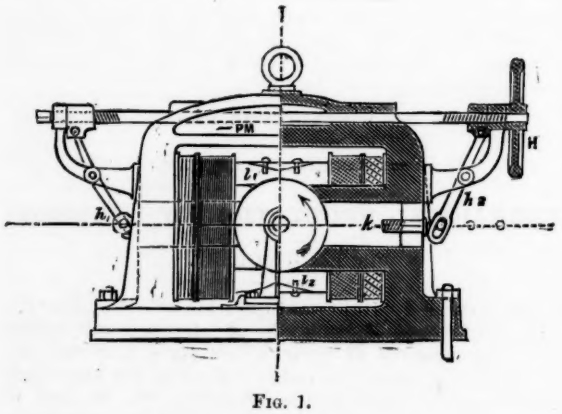

FIG. 1.

As it will be seen from fig. 1, the entire iron construction of the machine, with the plate, consists of a single casting, and has the form of the double magnetic connection, which has now met with repeated application. The machines brought forward for comparison depend on similar principles, and have a peculiar interest on account of their novelty. But a comparison of their different performances merits especial notice, in spite of the similarity of the outer form with the types here mentioned. The organs which act directly upon the magnetism are the two movable cores in the limbs of the magnets, k, which with the aid of the levers, h_1, h_2, and the screw-work moved by the hand-wheel, H, may be simultaneously displaced in opposite directions, and so exert a different influence upon the magnetic field, according to their position with respect to the armature. In addition to the fact that no work is lost uselessly in resistances, these may be dispensed with, and if regarded from a purely mechanical point of view the absence of the long circuit, with its many uncertain points of contact, may deserve attention, the more so as the entire regulating mechanism depends simply upon movements which have long ago been found trustworthy in the construction of machinery. If dynamos are deprived of some of their sensitiveness, often a cause of annoyance, the main object will be gained.

If a further step towards perfection, the regulation just described may be easily rendered automatic.

Such a regulation may be especially used with advantage in series machines for the electric light and for the transfer of power, as the compensating resistances otherwise used are dispensed with and the work thus wasted has not to be furnished by the motor.

If by applying this "mechanical regulation" a simplification (and consequently a greater certainty of working) of the dynamos can be effected, the justification of its use would follow as a matter of course.

A SYNTHETIC STUDY OF DYNAMO MACHINES.

(*Continued from page* 430.)

IV.—LAWS OF MAGNETIC INDUCTION.

14. *The Magnetic Circuit.*—We have considered at some length the E.M.F. induced in magnetic fields, but so far we have not considered how these fields are produced. We have been aided in our study by the conception of hypothetical fields which differ considerably from those found in practice, and our business is now to investigate the conditions necessary for obtaining in actual machines fields of the requisite strength and shape.

In all dynamos of modern build the field is produced by suitably contrived electro-magnets,* and the problem before us is to ascertain the relations existing between the shape, size and winding of electro-magnets suited to our purpose.

The lines of force emanating from a magnet form, as we have seen, closed curves, and the strength of field at any place in the region of the magnet is expressed by the number of lines of force passing through each square centimetre of a plane perpendicularly placed at that place to the lines. In the case of the straight electro-magnet (fig. 37) the flow of lines is shown by the dotted curves going through the interior of the magnet and circling round outside it from the N to the S pole. Let us endeavour to establish some relation between the lines of force, N, and the current, C, inducing them. The bar is of soft iron, and the magnetising coil A, is movable, the current through it being varied at will by means of a resistance not shown in the fig., and its magnitude ascertained by means of an ammeter likewise omitted. A switch is provided by which the coil, A, can be short circuited to create or annul at pleasure the magnetising force. Two or three turns of wire, B, are wound on the top of the magnetising coils, and the ends, twisted together, are led to a reflecting galvanometer, G, having a slowly swinging needle with a large moment of inertia. The

* There is only one exception known to the writer, that is the machine of De Meritens, so frequently employed for light-house illumination, which has steel magnets.

lines of force induced in the magnet necessarily flow through B, and a momentary current is therefore induced in these turns when lines are created or annulled. As long as their deflections are small, the swings of the galvanometer needle may be considered proportional to the lines of force induced, and we can now excite the magnets with different currents, and without knowing absolutely the number of lines ascertain by this method the proportionality between the current and the magnetism. The results plotted as a curve are shown in fig. 38. Here distances along A, B, represent current in ampères, while vertical heights represent the corresponding swings of the galvanometer needle, and therefore the lines of force. It will be seen that part of the curve near its origin is fairly straight, but that afterwards the curvature increases, the line slowly bending towards A, B.

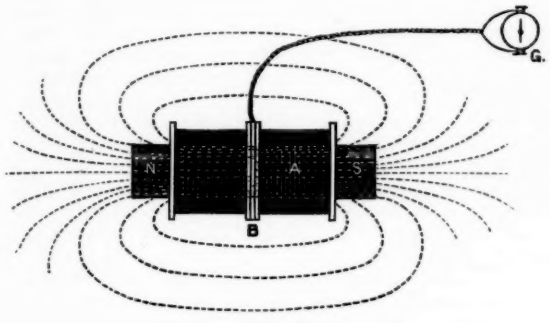

FIG. 37.

We will now slip off the magnetising coil and substitute in its place another having twice the number of turns, which occupy, however, the same volume. On repeating the experiment with the new coil we find, measuring the induction with the same turns of B, that each degree of magnetism is now induced by half the current. If the coil contains three times the turns, we find the current gives an induction equal to that which the first coil gave with three times the current. In each case the product of turns and ampères is similar for similar degrees of magnetism, and we conclude, therefore, that *the magnetising force is measured by the product of the current in ampères and the turns on the magnetising coil.* The effect is the same whether we have 100 turns with 10 ampères flowing or 1,000 turns with 1 ampére flowing, for the product in each case is 10,000. We shall hereafter talk of the magnetising force in *ampere-turns*, meaning by this term the product of the current in ampères and number of turns on the coil.

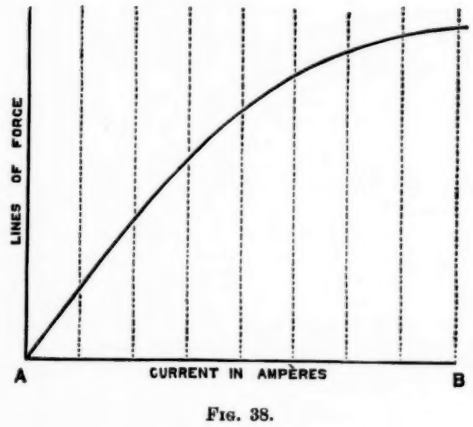

FIG. 38.

If we bend the bar to form a horse-shoe magnet, fig. 10*, we find that for low degrees of magnetisation the induction is much greater for the same ampère-turns than when the bar is straight, and this we explain by saying that the resistance to magnetisation has been diminished. The length of the bar may be the same in each case, but by bending we have brought its ends closer together, reducing, in consequence, the distance through which the lines of force have to pass through air in flowing from one pole to the other. The maximum magnetisation reached in the bent bar will be about the same as in the straight one, though the maximum will be reached in the former with a lower magnetising force. By bending the bar we have, besides diminishing the resistance, constrained the lines to take a particular direction. By properly shaping the iron we can evidently convey the lines without difficulty to wherever we require them, and the path of the lines so directed in dynamo machines is termed the *magnetic circuit.*

15. *Magnetic Resistance.*—From the fact that for magnetic induction a definite current is required, we may consider all substances as offering more or less resistance to magnetisation. The magnetising force required to produce the field increases with the resistance, and if we designate by resistance the ratio of the ampère turns, A, to the total number of lines, N, we have, calling $\mathfrak{R}$ the magnetic resistance, the relation

$$N = \frac{A}{\mathfrak{R}}.$$

In the magnetic circuit furnished by the bent bar, the lines of force flow partly in iron and partly in air, and our resistance is made up of two parts, one corresponding to the iron portion of the circuit, and one to the air portion. It may be seen from the curve, fig. 38, that the resistance for low magnetising forces is constant, N, increasing directly as A, but soon the ratio of the lines induced to the ampère-turns falls off, the curvature downwards gradually increasing as A becomes greater. The conclusion is that $\mathfrak{R}$ is not constant throughout for this circuit, but increases with the lines, and in our next article we shall determine how the resistance varies.

(*To be continued.*)

THE LECLANCHE AND GASSNER BATTERIES.

MOST of our readers are familiar with a paper upon the comparative merits of the Leclanché cell and the Gassner dry battery, read by Mr. Lant Carpenter on the occasion of the meeting of the British Association at Bath. In a recent issue of *La Lumière Electrique* we noticed a full report of Mr. Lant Carpenter's experiments, and of the conclusions he had arrived at. In the number of the same journal of the 27th October, we observe that M. Barbier, representative of the firm of Leclanché, undertakes the defence of the Leclanché cell. It is not our purpose to at present enter into a discussion on these batteries; later on we may have something to say on the subject. We should, however, point out that a most extraordinary discrepancy exists between Mr. Lant Carpenter's and M. Barbier's tests of the Leclanché cell. We are all aware that many inferior manufactures of the Leclanché are offered on the market, and as the value of the cell depends upon the quality of the materials used, and on the proportions of admixtures, it would be well, before coming to any definite conclusion, to learn from Mr. Lant Carpenter where he obtained the Leclanché cells he experimented with. There are cells and cells, and unless Mr. Lant Carpenter employed those of good type and make, it would be a mere waste of time to entertain for a

* See REVIEW, August 10th, 1888.

moment the idea of a serious discussion. And now for M. Barbier's letter :—

"I read in the last number of *La Lumiere Electrique* an article signed A. P., giving the experiments of Mr. Lant Carpenter on Gassner cells compared with Leclanché cells.

"M. A. P. concludes, and with very good reason, that it would have been interesting to have known the nature and sizes of the Leclanché cells in question. There can be no doubt, indeed, but that those of which mention was made could only have been the product of an inferior manufacture, such as one meets with, unfortunately, too often in business ; and you will permit me to prove that such is the case by placing side by side with the results obtained by Mr. Lant Carpenter certain figures collected by us with regard to the Leclanché cells of our various patterns, under conditions of work far less favourable. As a matter of fact, the experiments referred to in the article previously mentioned were made in a bell circuit of 20 ohms, while our experiments were made through 10 ohms with continuous current.

Consequently the work to which we submitted our cells, if the interruptions which occurred in the bell circuit are taken into account, were about four times more severe than that to which Mr. Lant Carpenter's cells were exposed.

"Well, even under these unfavourable conditions, we obtained, at the expiration of the same periods of time, differences of potential at the terminals much higher than those of the Gassner cells, as will be seen from the table hereto appended. It will be observed that the figures are so sufficiently conclusive that we can dispense with a comparison with Tables 2 and 3.

"The accuracy of our measurements cannot be contested ; we used a Deprez-d'Arsonval mirror galvanometer and Carpentier resistances ; and we compared the electromotive forces with that of the Post Office standard ; the results we give are averages of those obtained during a year on more than a thousand cells experimented upon."

DIFFERENCES OF POTENTIAL AT TERMINALS.

Time.	No. 1 Leclanché cell, porous pot. Through 10 ohms. Continuous current.	No. 2 Leclanché cell, porous pot. Through 10 ohms. Continuous current.	One plate Leclanché cell. Through 10 ohms. Continuous current.	Two plate Leclanché cell. Through 10 ohms. Continuous current.	Cylindrical cell. Leclanché type, small size. Through 10 ohms. Continuous current.	Gassner cell, round form. Through 20 ohms. Interrupted current.	Gassner cell, flat form. Through 20 ohms. Interrupted current.
H. M.	Volts.	Volts.	Volts.	Volts.	Volts.	Volts.	Volts.
0 10	...	...	...	...	...	1·21	1·05
0 15	...	...	...	...	...	1·20	1·03
0 20	...	...	...	...	...	1·19	1·015
0 30	...	...	...	...	...	1·17	0·997
1 50	...	...	...	...	...	1·10	0·78
3 45	...	...	...	...	...	1·043	0·712
22 5	...	...	...	...	...	0·833	0·548
24 0	1·06	0·85	1·03	1·07	1·13	...	...
48 0	0·93	0·67	0·99	1·03	1·12	...	...
48 10	...	...	...	...	...	0·778	0·447
72 0	0·77	0·59	0·97	1·01	1·08	0·728	0·364
96 0	0·71	0·53	0·93	0·98	1·03	0·695	0·298
120 0	0·66	0·49	0·90	0·97	1·01	...	...
144 0	0·62	0·45	0·86	0·94	0·98	...	...
168 0	0·59	0·42	0·83	0·90	0·93	0·618	0·171
E.M.F. at starting.	1·63	1·63	1·53	1·53	1·51	1·31	1·35

At the close of M. Barbier's communication our contemporary makes the following remarks :—"Our readers have now sufficient evidence upon which to form their judgment ; it only remains with us to congratulate ourselves on having called the attention of those most interested to these experiments, which owing to the immense publicity given to the labours of the British Association acquire a certain amount of importance, and we would again insist on the necessity of producing very accurate information as to the origin of any apparatus when, as in the present case, experiments or comparisons are published."

ELECTRIC LIGHTING IN BIRMINGHAM.

THE most complete and extensive installation of the electric light which has yet been attempted in Birmingham was tried successfully on Saturday night last. The Corporation Street Estate Company, Limited, has erected one of the most important blocks of business premises in the town at the corner of Martinea Street and Corporation Street, from the designs of Mr. J. P. Sharp. The building consists of 19 large shops and basements and two floors of spacious and well-ventilated offices over the same. The two upper stories of the building are arranged for warehouses, work rooms, or dwelling apartments, as may be required, and access will be given to these rooms by lifts worked by electric motors. The electrical plant and appliances have been designed by Mr. T. C. Sharp, C.E., and consist of two 50 I.H.P. semi-portable compound steam engines, which have been made by John Fowler & Co., Limited, of Leeds. The electric current is generated by two 600-light shunt-wound dynamos by Elwell-Parker, Limited, of Wolverhampton, who have also supplied large storage batteries, switchboards, and the necessary wiring and cabling.

Fowler and Lancaster, of Albert Works, Birmingham, have provided the lamps and fittings. When the works are quite complete the total number of lights supplied will be about 1,000 16-C.P. incandescent lamps inside the buildings and two 3,000 C.P. arc lamps on the exterior. The arc lamps supplied are of the Brockie-Pell pattern. One of the engines and a dynamo was run for five hours as a trial on Saturday with the most pleasing results, and the public frequently expressed their appreciation of the new light.

It is believed that this is the commencement of an important revolution in the lighting of the town, and that within a few years the adoption of the electric light will be quite general in Birmingham.

THE BREWERS' NATIONAL EXHIBITION.

THE tenth annual Brewers', Maltsters', Distillers', &c., National Exhibition and Market was held at the Agricultural Hall during the whole of last week, from October 22nd to the 27th.

Motors and the electric light form now an indispensable addition to these shows, and naturally were to be found at this special Exhibition. The class of prime motor, however, most shown was that of gas engines, and the principal makers of this class of motor had a large space allotted to them. The gas engines shown were generally, however, engaged in little more than showing that they could move their flywheels round, but there were several exceptions, notably at the exhibit of Messrs. J. E. H. Andrew & Co., Limited, of Reddish, where a small "Stockport" gas engine was steadily working a double force-pump, and another engine of larger power was driving a dynamo producing current for an installation of arc lights, 13 in number. This portion of the exhibit was arranged in connection with the Anglo-American Brush Electric Light Corporation, whose "Victoria" dynamo (C_2) was actuating 13 Sellon arc lamps (in parallel) of about 500 C.P. each. The "Stockport" engine driving the dynamo was an 8 H.P. nominal, and was connected direct to the dynamo pulley by a belt from the flywheel. The running was perfectly steady and even, and no fluctuations in speed could be observed by watching the tachometer in connection with the dynamo. An incandescent lamp of the Brush Company's new form of manufacture (not flashed) placed in the circuit gave no indication whatever of any variation in speed nor any sign of jumping or "pulsation," so commonly observed with gas engines.

The constant running of this engine throughout the week thoroughly establishes the statement of the makers that by reason of its steady motion, due to the piston receiving an impulse each revolution, it is

eminently suited for electric lighting. The Stockport engine has been elsewhere so frequently described, and is so well known, that further description is unnecessary, beyond noting that compression of the gas takes place in one cylinder before a charge is admitted into the power cylinder, where ignition takes place, enabling, therefore, an impulse to be given once in each revolution, which communicates steady motion to the flywheel.

The "Stockport" class of engine was shown in various sizes, from the "Baby," of ¼-H.P. (a very pretty piece of workmanship and finish), to the 14 nominal, fitted with Williams's special governor. Some of the engines were fired by tubes, instead of by the usual slide movement, a very decided improvement. We understand that the Stockport engine proved to be very much in demand, and that a large business was transacted, notably by several persons who had had previous experience of the running of the engine. The same installation will remain at the Agricultural Hall, and may be seen in operation again at the "Ironmongers'" Exhibition, which commences on Monday next, the 5th inst. To those in search of a first-rate prime motor for electric light work, we cannot do better than suggest that they should visit the Hall and judge for themselves.

REVIEW.

Les Produits Commerciaux et Industriels. Deuxième Partie. La Nomenclature de chaque produit avec ses variétés. En Français. En Anglais. En Allemand. En Italien. Et en Espagnol. Par W. F. BAYLES. Paris: Veuve J. Boyveau, Librarie Etrangère, 22, Rue De la Bangue.

This work is a most useful one, and appears to have been compiled with great care. Almost every branch of the technical arts appears to have been covered. It deserves to be widely known, as it is important for those engaged in commercial industries.

AMERICAN NOTES.

By DAS TELEPHON.

THE "Electric Torpedo," the testing and inspecting of which by the Naval Board of Ordnance I was invited to by the Hon. the Secretary of the Navy, is probably the most powerful weapon of defence invented by man.

This torpedo contains its own motive power, can be run fast or slowly, or in any direction, at the will of those on shore who have charge of it.

This messenger of destruction, to which the title of "Destroying Angel" has been given, goes hissing through the water at a speed of 24 miles an hour, the officer on shore directing all its movements by the manipulation of a simple electric key.

The torpedo consists of two cigar-shaped vessels, one of which is used as a float about three feet above the other, to which it is connected by four strong stanchions; the lower vessel projects in front about three feet beyond the upper one, and at its stern is a propeller, above which is the rudder.

Fore and aft on the upper vessel, which is the only one visible when the torpedo is on its message of destruction, are two flags which serve as sights by which the operator on shore guides it.

The upper cigar is 18 inches in diameter and 44 feet long; the lower one 24 inches in diameter and 40 feet long, and carries in its head from three to four hundred pounds of a highly explosive material, which is fired either by the percussion of the head against the side of a vessel, or by an electric current from the shore, as may be desired by the operator.

The lower vessel also contains the engines, which are of the 6-cylinder type, and the supply of compressed carbonic acid gas by which they are run; there is also a device by which the gas is heated, which is accomplished by coils of copper pipe incased in cylinders containing sulphuric acid with lime chambers at each end. The sulphuric acid and the lime can be brought into contact by the electric current sent from the shore, and the gas in one minute is raised up to 600 degrees F., and kept at that figure from one to three hours.

The engines, each of which occupies only 15 by 24 inches, can make 800 revolutions per minute, and each will develop 75 horse-power, truly a wonderful capacity for a 524-pound engine.

The great speed named can be kept up with but one charge of gas for a run of one and a half to two miles. As the charge can be fired by the electric current sent from the shore, if desired, or by concussion, the torpedo has all the advantages of self-propulsion, and is under the perfect control from the point whence it is sent; of course, when the torpedo is exploded against the side of a vessel, there is nothing left of either the vessel or the torpedo.

The entire topedo, with its propelling machinery, and its charge of dynamite, nitro-glycerine, or whatever other explosive is chosen, weighs but two and a half tons.

I think it safe to assert that under great speed, and such destructive power, such certainty of action, and such perfect adaptability to any emergency, has never before been devised or embodied.

At the Baldwin locomotive works in Philadelphia there are in course of construction four locomotives which are designed to run by soda, which takes the place of fire under the boilers. The inventor claims that soda has about the same heating powers as coal without any of the gases which coal emits. These locomotives, which is the name given here to railroad engines, are intended to be run in the streets in cities where steam engines are forbidden. It has the appearance of an ordinary passenger car, about 16 feet long, entirely boxed in, with no smoke pipes. The boiler is of the tubular kind, of copper 84 inches in diameter, 15 feet long; the boiler will contain five tons of soda, which upon being dampened by a jet of steam produces an intense heat. When the soda is completely saturated, which will occur in about six hours, the action ceases, and then it can be restored to its original state by forcing through the boiler a stream of super-heated steam from a stationary boiler, which drives the moisture entirely from the soda, when it is again ready for use.

One of these engines will run four cars carrying 300 persons.

These engines are the first of their kind built in the United States, and are being constructed under the supervision of George Kuchler, a German engineer.

I cannot vouch for all that is promised for these engines, but I give you the description given me by Mr. Kuchler on my visit to the Baldwin works.

A new dynamite gun has lately been under examination by a board of army officers, and if the report of its performance be not exaggerated, it is more destructive than any of the present submarine torpedoes like the Whitehead, and much more reliable in its action. The destruction of a vessel of about 200 tons, at a distance of more than a mile by a charge of only 50 lbs., was sufficient to demonstrate the wonderful accuracy of the gun and also its destructive capacity. The manufacturers claim that at a distance of one mile they will destroy any vessel of the United States Navy (by way of parenthesis, I will say that it would be a good thing if all the veesels of the United States Navy were blown to atoms, for then, perhaps, we might build some serviceable ones).

Light is thrown upon the ways of corporations in this country by the annual meeting of the stockholders of the Western Union Telegraph Company. It is a company with over $86,000,000 of capital, and just four men attended the meeting to receive the report presented by the President, Dr. Norvin Green. Mr. Sam. Sloan was present to preside, Mr. John Terry was on hand for the lunch (the great event of the meetings), while Dr. Norvin Green and director Van Horne appeared chiefly perhaps because they are both earning their daily bread in the Western Union building and could not well escape. The report was approved and the following board of directors was elected for 1888–9; Norvin Green, Thomas T. Eckert, John T. Terry, John Van Horne, Jay Gould, Russell Sage, Cyrus W. Field, Robert C. Clowry, Henry Weaver, Percy R. Pyne, Austin Corbin, J. Pierpont Morgan, C. P. Huntington, George B. Roberts, Charles Lanier, Edwin Gould, Erastus Wiman, Alonzo B. Cornell, Sidney Dillon, George J. Gould, Samuel Sloan, Frederick L. Ames, John Hay, William D. Bishop, John G. Moore, John J. Astor, Chauncey M. Depew, James W. Clendenin, Sidney Shepard, and Henry M. Flagler.

Washington, *October 19th*, 1888.

INSTITUTE OF MEDICAL ELECTRICITY.

THIS institute has at length become an accomplished fact, and on Tuesday evening the directors gave an inaugural *conversazione* to a large number of their electrical, medical, and other friends. The institute itself is at 24A, Regent Street, the entrance being in Jermyn Street; but the *conversazione* took place at the rooms of the Medical Society of London, in Chandos Street, Cavendish Square. Ample provision was made for the entertainment of the guests. Electrical and medical apparatus and other appliances and instruments of a very interesting character, kindly lent by various firms, were displayed in profusion; the graphophone, presided over by Mr. Henry Edmunds, held numerous *seances*; and music by Mrs. M. A. Carlisle and Mr. George Colvill, followed by a lecture of a popular and exceedingly interesting character by Prof. S. P. Thompson, D.Sc., on "Old and New Views of Magnetism" charmed away a large part of a very pleasant evening.

The objects of the institute were so well set forth by the chairman of the board of directors, Mr. Wm. Lant Carpenter, B.A.

B.Sc., in his address of welcome, that we cannot better illustrate the intentions with which the new enterprise is entered upon than by reporting his remarks. Having bid his guests heartily welcome, he besought a hearing for a few words of explanation. The progress of physiological research, he said, during the last few years has abundantly demonstrated the fact that phenomena hitherto classed as vital have to be examined and discussed by chemical and physical methods, and that the so-called vital processes are accompanied by manifestations familiar to the physicist. Of these electrical phenomena are very frequent. Having referred to a summary of them in a British Association lecture by Prof. McKendrick (delivered at the Southport meeting), Mr. Lant Carpenter proceeded to remark that of the opening addresses in the London medical schools in the beginning of the month, probably none was more valuable, and certainly none excited more general interest, than that of Dr. Augustus Waller, of St. Mary's Hospital, on the electrical action of the human heart. He was happy to say that Dr. Waller is one of the visitors of the institute, and he had already given very valuable aid. Although it might seem a somewhat personal matter, his auditors would perhaps permit him to add that the subject of the last scientific conversation he had with his father, the late Dr. Carpenter, whose physiological researches were known to many of them, had reference to some work upon which he (Mr. Lant Carpenter) was then engaged, relating to the physiological aspect of electricity. Moreover, during the last few years much excellent work has been done in some of our largest hospitals, in order to ascertain under what conditions the electric current, properly applied, may be available for the cure or alleviation of disease. In many cases the results have been most remarkable, and have justified the fitting up of electrical departments in those hospitals, with all the appliances that experience can suggest for the application of this powerful therapeutic agent. A large store of facts as a guide to future scientific and curative work has thus been accumulated. Having a knowledge of these facts, the promoters of the institute felt that while these advantages were open to the poor and to non-paying patients, there was no place where people of moderate means could obtain electrical treatment of a corresponding character; they also felt, with regard to medical specialists, the expensive character of the instruments employed, and the special nature of the training required, necessarily restricted the services of those gentlemen to a comparatively limited class, the wealthy. The promoters therefore consulted medical men of large experience, from whom they learnt that many of them often wished to employ electricity, but had neither the time, the opportunity, nor the special knowledge necessary to apply it, and that they would welcome facilities in this direction. The opinion of electricians was then sought, and similar encouragement was derived. Electricians were specially anxious, having regard to the enormous amount of quackery prevailing, that something should be done promptly to put the real practice of medical electricity on a satisfactory scientific footing. To all those gentlemen, whether in the electrical or the medical profession, who had aided the institute by active assistance, advice, or the moral support derived from their position, the directors desired to give their sincere thanks, and they wished especially to acknowledge their indebtedness to the editors of the *British Medical Journal*, the *Electrician*, the ELECTRICAL REVIEW, *Health*, the *Hospital*, and the *Medical Press*. After mature consideration as to the best position for their establishment, they took the premises at 24A, Regent Street, and had expended a considerable sum in fitting up apparatus, acting in this matter under the advice of some of the best experts in medical electricity. The distinctive feature of the institute is that no electrical treatment can be administered except under the advice of a medical man. The institute also offers facilites to medical men for treating their own patients with the apparatus at the institute, or, in special cases, at their own residences. Moreover, there will be facilities in the institute for physiological research, and this the directors wish to encourage as much as possible, believing that only on such a sure foundation can good curative work be achieved. The institute began to receive patients early in October, and is now open to inspection. Mr. Newman Lawrence, the managing director, to whose indefatigable and self-sacrificing efforts the directors desired to bear testimony, would be glad to show any visitor over the premises and explain the apparatus. One other feature remained to be noticed, namely, the branch at Southsea, which was really of older date than the London establishment. Many local medical men, including members of the staff of the great military hospital at Netley, had testified to the benefit which their patients had derived from treatment at the Southsea branch. If they asked him how they could help the institute, he would say, first of all, by informing themselves as to its work, then by making it known among their friends, and especially among those members of the medical profession with whom they might be acquainted. The institute was formed to meet a want which the medical profession said was a decided one, and it depended very largely upon that profession whether it should succeed or whether the great amount of time and money expended by some of the promoters should be thrown away.

Mr. Lant Carpenter's remarks were received with applause, and at a later stage, in proposing a vote of thanks to Prof. Thompson for his lecture, the Earl of Winchelsea and Nottingham expressed the sympathy of the visitors with the objects of the institute and wished it every success.

The party dispersed about midnight, Mr. Lawrence and Mr. Carpenter receiving many assurances of the pleasure the visitors experienced in assisting at the inaugural *conversazione* of the Institute of Medical Electricity.

THE ELECTRIC LIGHT IN HALIFAX.

THE largest installation of the electric light in Halifax, and the largest of its kind in England, we believe, is that just completed in the new mill in Miall Street, Pellon Lane, belonging to Messrs. Hollingrake and Clegg, worsted spinners. The mill is of stone, designed by Mr. James Farrar, of Northgate, and is five storeys high, seven windows in breadth, and 19 windows long. Two splendid engines have been supplied by a Brighouse firm, Messrs. Woodhouse and Mitchell, and run with remarkable steadiness. The driving power is by means of four leather belts, one of which is 18 inches broad, two 24 inches, and one 29 inches. A patented and ingenious apparatus indicates with accuracy the steadiness or otherwise with which the engines run, and in this respect it would be difficult, we should imagine, to get better results.

This new mill is devoted almost entirely to the spinning of coloured yarns. Unless one were to see the yarns in progress it would scarcely be conceived that so many colours were used in men's clothing. The variety of shades is almost numberless, and it is the difficulty of working up these coloured yarns in gaslight that has led the firm to adopt the electric light. The installation has been supplied entirely by the Schmidt-Douglas Electric Company, Limited, of Bradford, who are, it may be remembered, at present proposing to the Corporation to light the borough of Halifax, and whose application is at present under consideration.

A large dynamo supplies current to 60 arc lamps of 2,000 C.P. each, and 500 incandescent lamps 16 and 32 C.P. each. The light is supplied to every department of the mill, from the fine engine house to the top room. In the bottom room of the mill, where are carried on drawing and roving, incandescent lamps are used, the number being the same as the gaslights formerly used. The result is all that could be desired—a pleasant, steady light, better than the gas, and without the heat and dirt arising from it. Adjoining this floor is a shed used for warping and winding. Here the contrast with gas is much more marked. Eight arc lamps are inserted, which give a pure and beautiful light, so that the operatives find no difficulty at all in working among the delicate shades of material. In another part of the shed warping is carried on, and for that department the incandescent lights of 32 candle-power are used to each warping mill. The re-combing of dyed wool is done in an adjoining shed, which is also lit up with arc lamps. The two colour matching rooms have respectively two and four arc lights, which give a most soft and cheerful appearance. Proceeding from room to room up the patent safety hoist, the incandescent light is seen burning brightly and steadily, and illuminating in a most satisfactory manner the spinning and twisting departments carried on there. In the fifth or top room, devoted to drawing and roving, there are two rows of arc lamps, 16 in all, used again with excellent effect. The colours of the yarns show almost as clearly as in the daytime. Even in the apartment where the stock of botany tops is kept, and where only the incandescent light is used, there is no difficulty in defining the host of fine shades.

The *Halifax Courier* thinks that it is as yet too early to speak definitely as to results. So far they are eminently satisfactory; and as to the future, it certainly indicates the confidence which the electricians have in their installation, in that they have undertaken the maintenance of the system and to do all repairs for a period of seven years, at a fixed amount.

The End of the World.—An American clergyman has made the discovery that in just 32 years the electricity stored in the earth will come in contact with the heat inside and blow the world up. Unfortunately, most of us will not be there to see; but if Mr. Johnson is still in the flesh in 1921, it is to be hoped that some one will make him show where his calculations were at fault.

COPPER.

FOR everyone interested in the production and consumption of this metal, as well as the position of the different copper mines all over the world, the following semi-official *data* about the contracts entered into by the Société des Métaux may prove very useful. We (*Money*) give the figures without any further comment, and only wish to draw the attention of our readers to the fact that the different agreements involve an annual liability for the Copper Syndicate of fully 12 millions sterling.

Name of company.	Annual production in tons as agreed.	Duration of contract.	Price of copper per ton.	Approximate liability of Syndicate in 1,000,000 omitted.	General remarks.
			£	£	
Rio Tinto	25,000	3 years till 31/12/90	65	1,625	
Tharsis	11,700	3 „ „	65	760,5	
Mason and Barry ...	7,000	3 „ „	65	455	
Bratsberg	400	3 „ „	65	26	
Vigsnaes	1,100	3 „ „	65	71,5	
Panulcillo	3,000	3 „ „	65	195	
Cape Copper	5,750	3 „ „	70	402,5	Guaranteed by Comptoir d'Escompte, with option for further 3 years.
Namaqua Company	1,768 in 1888 2,240 in 1889 2,720 in 1890	3 „ „	63/15	143	Less cost for smelting £9 10s. per ton. The smelting of this ore is done by the Cape Copper Co. for account of the Synnicate.
Quebrada Company ...	4,320	3 „ „	70	302	Minus actual expenses for smelting.
Tilt Cove	4,650	3 „ „	70	325,5	
Bett's Cove	1,200	3 „ „	70	84	
Calumet-Hecla	22,320	3 „ „	61/10	1,373	
Quincy	4,400	3 „ „	61/10	270	
Tamarack	7,440	3 „ „	61/10	457,5	
Atlantic	2,640	3 „ „	61/10	162	
Franklin	2,520	3 „ „	61/10	155	
Osceola	1,900	3 „ „	61/10	117	
Huron	1,440	3 „ „	61/10	88,5	Share—half in profit over contract price.
Parott	5,000 in 1888 5,500 in 1889 6,000 in 1890	3 „ „	61/10	338	
Boston and Montana ...	15,000	3 „ „	60	900	
Arizona Company ...	3,000	3 „ „	61/10	184,5	
Copper Queen	2,800	3 „ „	61/10	172	
Old Dominion	650	3 „ „	61/10	40	
Moonta	1,880	2 years	£5 beyond average quotation of Chili bars.	131,5	Anything realised over £65 by the Syndicate is shared half between the latter and the company.
Montana Mines	26,000	6 months, with option to renew.	61/10	1,599	Share half profit.
Tanpa Mines	10,000	12 months	65	650	
Boleo	5,000	3 years till 31/12/90	65	325	
Total tons per annum ...	175,853			11,353,000	

Besides which the Syndicate is under contract to take all the copper produced in America by the electrolytical process, amounting to about 10,000 tons annually.

Mr. Doetsch, the leading director of the Rio Tinto Company, succeeded last week in extending the contract with the Syndicate for another twelve years, *i.e.*, till 31st December, 1902; and this agreement has been confirmed. The basis of the new arrangement is a higher selling price for the mines, whilst the Société des Métaux becomes simply the broker between the copper companies and a bank to be established in London, as well as in Paris, and the shares of which will be offered for public subscription in the first half of next month.

LEGAL.

Jacker v. The International Cable Company, Limited.—Court of Appeal.—(Before the MASTER of the ROLLS, LORD JUSTICE FRY, and LORD JUSTICE LOPES.)—Monday.—This was an appeal from the judgment of Mr. Justice Hawkins in favour of the defendants at the trial without a jury. During the hearing of the appeal a question of practice incidentally arose. A document was admitted in evidence at the trial by Mr. Justice Hawkins which the Court of Appeal thought was wrongly admitted, and the question was whether the Court of Appeal would disregard this evidence. The MASTER of the ROLLS said that the point of practice arose where the action was tried by a judge without a jury, where the judge was the judge of the facts. The point was this—supposing certain evidence wrongly admitted before the judge at the trial, either after objection taken or by inadvertence or otherwise, was this Court bound to take notice of it for the purpose of its decision, because it was admitted, even without objection, before the judge? His lordship was of opinion that they were not bound to notice it. If counsel did not object to the evidence at the trial, and it was put in, it was the duty of the judge to reject it when he came to give his judgment, and this Court would do so; or if it was objected to and admitted, this Court was bound to reject it. They were not bound to admit it, and their duty was to arrive at a decision upon legal evidence. LORD JUSTICE FRY concurred. LORD JUSTICE LOPES said that in cases where evidence was improperly admitted before a judge without a jury, it was the duty of this Court to disregard it, though it had been received without objection, as they ought to decide the case upon legal evidence. The COURT, upon the facts, allowed the appeal.

In re Maxim-Weston Electric Company, Limited.—Mr. Hugh Watt, M.P., presented a petition for the winding up of this company. The petitioner claimed to be a creditor of the company. Mr. JUSTICE CHITTY made an order by arrangement between the parties that the petition should be dismissed upon £500 being paid into court, to stand there in the joint names of the solicitors of the petitioner and of the company to abide the result of proceedings to be taken by the petitioner to establish his claim. The costs of the petition he directed to be paid by the company if the petitioner should succeed in establishing a balance in his favour exceeding £50, otherwise the costs to be paid by the petitioner.

The Electric Light at Leamington.—Strenuous efforts, the *Birmingham Post* says, are being made to improve the electric lighting system in Leamington, and it is expected that three new methods of using the light for purposes of street illumination will be before the public by the end of next week. In York Terrace new incandescent lamps of 300 candle-power will be substituted for a number of the present 16 candle-power lights, the result being that 1,000 candle-power more light will be provided for that part of the town than has hitherto been supplied. Lamps of the "Sunbeam" pattern will be used. In the Parade four new arc lights will replace about 29 of the existing lights. These will be suspended from poles 25 feet in height. It is proposed to improve the light in Bath Street by placing two 25-candle-power lamps on each lamp-head. It is stated that the light will be all that can be desired when the improvements have been made.

NOTES.

Bradford Electric Lighting Works.—What was described as the foundation stone of the Bradford Electric Lighting Works, in Canal Road, was laid last Friday morning by Alderman Frederick Priestman, Chairman of the Gas Supply and the Electric Lighting Committee, in the presence of a large number of spectators. The Mayor presented Alderman Priestman with a silver trowel and mallet, both of beautiful design, with which to perform the ceremony of laying the stone. Canon Bardsley asked a blessing on the work, and Alderman F. Priestman performed the ceremony, with the usual formality. Addressing the assemblage, he observed that he should ever be pleased to have his name associated with the electric works, as he felt sure electric lighting would become a great commercial industry, and Bradford would have the honour and distinction of being the pioneers in the work. The works were in a forward state, the cables were in Bradford, and the other portions of the machinery necessary were so near completion that he hoped the works would be finished at the beginning of next year. Alderman Priestman said that Mr. Shoolbred thought they would be completed about the middle of December. Concerning the price to be charged, he said it was not the intention of the committee to supply anything but the electric current, and customers would have to make their own arrangements for the fixing of lamps of whatever power they required with other engineers. In supplying the current it would be charged either by meter or the number of hours the light was used, and if intending customers would only take the trouble to see Mr. Shoolbred and explain the kind of light they intended having, he would give them an idea of the cost. Alderman Priestman said that Bradford was to be congratulated on ordering its plant when it did, for since then the price had considerably increased. Votes of thanks to the Mayor, Alderman F. Priestman, and the Vicar of Bradford brought the proceedings to a close.

The London Electric Supply Corporation, Limited.—The central station of the corporation at Deptford being now well advanced, the directors are prepared to receive orders for the supply of electric current for execution early in the ensuing year. The station will be capable of supplying 250,000 lamps in the first instance, and arrangements have been made for extensions, as the demand increases, that will give a supply of current for two million lamps. The supply will be continuous, and available at all hours of the day and night. The corporation does not undertake the fitting up of wires, &c., on the premises of consumers, but the directors will be very happy to give advice and assistance to any persons applying for the same, and will send an experienced representative for this purpose when desired to do so. In view of the large and increasing demands for electric current, it is very desirable that early applications be made, as the corporation's distributing mains will be carried to those localities where there is the greatest demand for current. Applicants will be supplied in the order of priority of their applications, The charge will be by meter, at the rate of 7½d. per Board of Trade unit, but for special installations having a very large number of lights, the directors will, if preferred, contract to supply current at a fixed rate per lamp per annum, based upon estimates of the proposed use to be made of the light. The corporation requires in all cases a guaranteed minimum rental of £20 per annum.

The Lighting of Allendale Town.—Complying with a request of the Town Improvement Committee, Mr. Milburn, of Newcastle, last week gave an experimental trial of his patent system of electric lighting at Allendale Town, and it gave great satisfaction. A committee meeting was afterwards held, when Mr. Milburn explained his system of lighting the town, which was considered remarkable for its cheapness and simplicity, and he was requested to forward an estimate of the cost.

Liverpool and the Electric Light.—The Watch Committee of the Liverpool City Council, at its last meeting, had a letter before it from the Liverpool Electric Supply Company, Limited, applying for the consent of the Corporation to the company making application to the Board of Trade for a provisional order under the Electric Lighting Act, 1888. The committee, after considering the matter, passed a resolution that as the company is only just beginning to work under the Liverpool Electric Lighting Licence, 1888, which has been granted by the Board of Trade, it be informed that until sufficient time has elapsed to enable the Council to see how it has carried out the provisions of the licence, the committee cannot recommend the Council, as the local authority under the Electric Lighting Act, 1888, to consent to the company making an application for a provisional order.

Ballroom Lighting.—At an evening party held on Tuesday, October 22nd, in Beckenham, the electric light was introduced. The dancing room was illuminated during the whole evening with an incandescent lamp of 300 candle-power. Another lamp of 200 candle-power was erected at the entrance of the carriage drive, affording a welcome illumination to the coming and departing visitors. The coolness of the dancing room was particularly noticeable, and thoroughly appreciated. The smoking concert held by the Lewisham Bicycle Club last Saturday evening was also effectively lighted by Messrs. Arthur B. Gill & Co.

Exeter and the Electric Light.—At the last meeting of the Exeter Town Council the special committee on electric lighting reported that they had opened tenders for lighting the selected district with electricity as follows :—Exeter Electric Light Company, £22 17s. 6d. per lamp per annum ; Messrs. C. Allen and Son, Taunton, overhead £24 per lamp, undergrounnd £28 10s. by the Thomson-Houston system, or £21 and £25 respectively by the Brockie-Pell or Pilsen-Joel systems ; Messrs. Newall & Co., by the Thomson-Houston system overhead £23 10s., underground £27 10s., or by the Brush £25 10s. or £29 10s. ; Messrs. Sharp and Kent, overhead £35, underground £40 ; Anglo-American Brush Electric Light Corporation, Limited, overhead £43. The whole of the above figures were on the basis of a seven years' contract. The lowest tender represented a cost of £1,486 17s. 6d. per annum, while the present cost of lighting the same district by gas was, according to the surveyor's report, £666 11s. 8d. The surveyor reported to the committee that the total illuminating power of the existing gas lamps at the posts would be 2,000 C.P., while that of the electric light would be 32,000 C.P. Having regard to the large increase of cost as compared with that of gas, the committee did not recommend that any of the tenders should be accepted. Mr. Townsend, in moving the adoption of the report, said he thought that the recommendation of the committee would be endorsed by the ratepayers, who would say that in taking the course now proposed the committee would be justified, seeing that the price was so much in advance of what they hoped it might be. Mr. Wilson thought that the report showed the worst side of the electric light question ; still, he was not prepared to support any change being made until they could get electricity at the same price as gas. The report was adopted.

House Lighting.—We learn that Messrs. Drake and Gorham have recently completed an installation of about 150 lamps at Rodborough Court, Stroud. An Elwell-Parker dynamo is used in conjunction with a Crossley gas engine, fitted with tube ignition batteries, of the firms lattest pattern, for 46 lamps are provided.

Electric Light in Dublin.—The Dublin Corporation on Monday, by twenty votes to two, adopted the report of the whole house recommending that steps be taken to supply electricity for private as well as public purposes, and that a special committee be appointed to give effect to the provisional order.

The Electric Light at Frankfort.—The electric light would hardly appear to have been giving great satisfaction at Frankfort Station, says the *Gas World*, for experiments have been made there with 470 petroleum lamps. The light suddenly went out for a quarter of an hour one evening, and the restaurant people had to get stearine candles lit in order to collect their customers' payments.

Electric Light on the Stage.—Of spectacular displays probably one of the most successful ever put upon the stage is that given at the end of the new ballet which was presented for the first time on Wednesday last at the Empire Theatre. Much of the effect is due to a use of the electric light on a scale considerably in excess, we believe, of anything hitherto attempted in this way. Each member of the *corps de ballet*, to the number of 58, is supplied with a small electric lamp in the hair, attached by a comb, the current being derived from a primary battery of four cells measuring about 3½ inches by 2½ inches, and weighing under 3 lbs., which is secreted at the waist. The fitting of this large number of lamps to the wearers, which has to be completed during an interval of about nine minutes, is a piece of smart work. A personal inspection enables us to say that the electrical arrangements are carried out in the most perfect manner by Mr. Richard Allbright, under the direction of Madame Katti Lanner.

Chelsea Electricity Supply Company, Limited.—This company is issuing a circular to the residents of Chelsea setting forth the conditions under which it is prepared to supply electricity in "District A." The company makes the most of its intentions to employ accumulators, speaking of the "well-known risks of what is known as the transformer system," and stating that "one important objection to that system—namely, that conductors conveying high tension currents dangerous to life enter the premises of each consumer—is avoided."

The Telephone in Belfast.—Since its establishment in Belfast more than eight years ago, the National Telephone Company has made considerable progress in the development and improvement of telephonic communication. At present 480 subscribers' and almost 120 private lines are served by the exchange; and, as an instance of public appreciation, it may be mentioned that negotiations are at present proceeding for the establishing of communication with very remote places in the North of Ireland.

The Telephone Answers.—An instance of the value of the telephone occurred the other day at Dover. A popular concert was to take place at the Town Hall, and amongst the singers was Mr. Orlando Harley, a well-known tenor, who was touring with Mr. Santley. On Mr. Horscroft, the conductor, arriving at Dover in the evening he found a telegram announcing the inability of Mr. Harley to be present owing to illness. It was then 6.5 p.m. The party were in a dilemma. Mr. Kennington, of Canterbury Cathedral, was thought of, but then there was only 25 minutes, and the telegraph was useless when time was so limited. Suddenly it was remembered that telephonic connection had just been established between Canterbury and Dover, and it was determined to try what could be done with the telephone. Mr. Kennington was found at the Conservative Club, and lost no time in hastening to the station, and succeeded in catching the 6.30 train for Dover, where he arrived in time to take part in the concert.

Electricity and Mining.—The *Financial News* hears that the prospectus of the Humboldt Electric Power and Mining Company, Limited, will be issued next week under good auspices.

The Phonograph and Graphophone.—A lengthy letter on this subject from Mr. A. A. Campbell Swinton will appear in our next issue.

Australasian Cables.—The Eastern Extension, Australasia and China Telegraph Company notifies the restoration of communication with Australia and New Zealand.

Thomson-Houston Lamps.—The gas company of Lawrence, Kan., has purchased 70 2,000-candle-power Thomson-Houston arc lamps. A fine new stone building was erected by the gas company for the accommodation of the new plant. Motive power from the Kansas River will be used for about nine months in the year, but the company has the best of steam power at hand whenever necessary. It is the intention of the gas company to add 1,600 incandescent lights very soon.

The London Chamber of Commerce.—To members of the Electrical and Allied Trade Section.—The following is a translation of a paragraph which appears in a report of the Belgian Consul-General on openings for the investment of foreign capital in the Canary Islands:—"Electric lighting is also wanted at St. Croix (Teneriffe) and Las Palmas (Grand Canary), and a contract would be made with a company willing to undertake it. It is the same for the telephone for the various towns of these Islands." The full report may be consulted at the offices of the Chamber, Botolph House, Eastcheap, London, E.C.

The Management of Accumulators.—It is known to those who study the literature of secondary batteries that for some two years or more Mr. W. J. S. Barber Starkey has been using sulphate of soda as the electrolyte in his storage cells, and he has always found it prevent injurious sulphating of the plates. Recently he left home for three months, and during that period the cells were never charged. He examined them on Wednesday morning, and could detect no difference in their appearance from the time they were last charged; they seemed to be in perfect order, the peroxide plates a dark brown, and the others like clean metallic lead. There was not a trace of white sulphate on any of the plates, and they light up the lamps as brightly as if they had been just charged, although they have been left to themselves since August 6th. The cells have been in use for about three years, and although at first Mr. Barber Starkey was troubled by the sulphating and bending of the plates, he has never experienced any trouble of any description since he added carbonate of soda to each of the cells, two years ago. He can now leave the cells with perfect confidence, if required, for several months without any charge. His charging current has always been limited to 12 ampères, but is generally only 10, and he always stops charging as soon as any gas is given off, although he is quite aware that this course is not usually adopted. Mr. Barber Starkey will be pleased to show his accumulator, which not only lights the house, but supplies the current for an electrically blown organ, to anybody really interested in such matters.

The Schanschieff Electric Battery Syndicate, Limited.—Mr. David Marks has resigned his office as director of this company, being about to proceed to Australia, and Mr. T. Grant Wells has been appointed secretary, *vice* Mr. John Wright.

The Electric Tram in Birmingham.—On Monday night a further experiment was made by the Central Tramway Company with the tramcar driven by an electric motor. The car left Kyott's Lake depôt shortly after 11 o'clock, and proceeded to Sparkhill, and thence to John Bright Street, and along the Moseley route The journey was completed satisfactorily until the car reached the corner of Edwardes Street, in the Moseley Road, where a delay occurred owing to the overheating of some of the bearings. Ultimately the car was taken back to the Kyott's Lake depôt. The engineers of the company consider the experiments eminently satisfactory.

The Effect of a Galvanic Shock.—At the Manchester Police Court, on Monday, James Smith was charged with defrauding the railway company. On Saturday night he was discovered insensible and without a ticket in a train, and was conveyed in an ambulance to the infirmary. He wrote on a piece of paper that he was deaf and dumb. The doctors, however, being sceptical, applied a galvanic battery, when the prisoner jumped up and shouted, "My name is Smith, and you may put me down a rogue." He was fined 10s. 6d., or 14 days.

Lecture.—A popular lecture on "The Present and Future of Electric Locomotion," with special reference to tramcar traction, was delivered at the University College, Nottingham, last Friday, by J. A. Fleming, M.A., D.Sc., Professor of Electrical Technology in the University College, London.

Specification for a Lancashire Boiler.—The proprietors of the *Practical Engineer* have just issued in a collective form a series of articles which recently appeared in that journal, by Mr. William H. Fowler (late assistant engineer to the Manchester Steam Users Association), forming a full detailed specification for a Lancashire boiler 7 feet 6 inches diameter, embodying the best and most recent practice with regard to its construction and method of setting. No doubt the want of such information of a reliable character is frequently felt, not only by steam users, but also by architects and members of the engineering profession generally, whose work often renders it of great convenience to have such a document at hand for reference, and we have pleasure in calling the attention of our readers to its publication.

American v. English Practice in Electric Lighting.—The rough and ready manner in which American electric light engineers set to work when erecting distributing plant has been repeatedly criticised in England, says the New York correspondent of *Industries*, and the opinion seems to prevail with you that while our stations and machinery are extremely good, our line construction is inferior. I regret to say that this opinion is perfectly correct. The experience gained in the construction of telegraph and telephone lines has not been utilised as it should have been by electric light engineers, and this has brought about the present agitation against overhead lines. The leniency of the public in permitting electric light companies to erect distributing plant in a most temporary manner, is one of the reasons why the development of electric lighting as a business investment has been more rapid in this country than in England. I think Professor Forbes is in error when he attributes this development to the greater technical knowledge of our capitalists. I do not deny that certain capitalists have been aided by their own technical knowledge; but the main reason of our commercial success in electric lighting is that the principle of *laissez faire* has been allowed to rule to an extent which, from the point of view of public safety, is almost reprehensible.

The Blackpool Tramway.—The following has just come to hand as we are going to press:—If Mr. Holroyd Smith regards my letter anent the Blackpool Tramway as an attack upon himself, I can only say that he is greatly mistaken. No such intention ever entered my mind. Rather than feel annoyed that a small alteration in detail should make his system a success, he ought to feel supremely happy. But since Mr. Smith has chosen to attack me on the plea (1) that the first insulators I made were badly glazed; (2) that my new patent insulator possesses no special feautures; and (3) that the success of the tramway is due to the care of the manager and to better glazing, rather than to anything else, I must, in self-defence tell him, without wasting your space again by going into detail (as I did last year), that the whole of his contentions are in direct opposition to theory, practive, and fact, and I challenge him to substantiate one single statement which he has adduced in support of his case.—J. SLATER LEWIS.

The Society of Telegraph Engineers and Electricians.—On Thursday, November 8th, 1888, an ordinary general meeting, at 8 p.m., will be held, and a paper read "On Ocean Temperatures in Relation to Submarine Cables," by W. Lant Carpenter, B.A., B.Sc., member. A special general meeting of members will be held at the Institution of Civil Engineers, 25, Great George Street, Westminster, on Thursday, the 8th day of November, 1888, at 7.45 o'clock p.m., when the subjoined resolutions will be proposed: 1. That the name of the society be changed to "The Institution of Electrical Engineers." 2. That the office of Honorary Secretary be abolished, and that the articles of association be altered by omitting all reference to the Honorary Secretary in articles 36, 38, 40, and 43.

Cassell's New Popular Educator.—That sterling educational manual, "Cassell's Popular Educator," which has in the past proved of invaluable service to many thousands, has undergone complete revision, necessitated by the great change which has since its first issue taken place in the educational condition of Great Britain, the increasing intensity of competition, and the extended facilities for merely primary education. The revised "Popular Educator" is practically a new work, and the comprehensive and enlarged basis upon which it is reconstructed should enable it to accomplish as effectively for the present generation that which it has achieved in its original form. We wish the enterprising publishers every success in their endeavours to supply the people with the means of self-instruction. The only safeguard in this era of extended power amongst what are usually styled the lower classes is in the spread of intelligence and education, and it must be confessed that Messrs. Cassell & Co. are doing their share towards securing this end. The issue of the Doré Bible in weekly halfpenny numbers is a noteworthy demonstration of the firm's belief in the strong desire of "the people" for a higher standard in art and literature.

Proposed Electric Tramway at Gosport.—The British Tramways and General Syndicate is promoting a scheme for the running of an electric tramway between Gosport, Alverstoke, and Bury Cross. The matter having been referred to the Roads and Works Committee of the Alverstoke Local Board, was considered at a special meeting on Tuesday. Mr. J. E. Haynes, engineer to the promotors, explained the scheme in detail. It was stated that the undertaking is in most respects similar to that now being promoted in the New Forest by the same company. The proposed line will be in three sections, the first from Upper High Street to Bury Cross, the second from Bury Cross through Privett Lane to Gomer Lane, from whence it will in all probability be extended at some future date to Lee-on-the-Solent, and the third from the railway arch at Gosport Road Railway Station along Mr. House's new road to the village of Alverstoke. The metals are to be of the three-foot gauge, and the motive power of the cars electricity, which will be generated at a permanent station near the town terminus of the line, and stored in accumulators under the seats of the cars. It was unanimously resolved by the committee to recommend the scheme for the sanction of the Local Board. In case no opposition is encountered, and none is expected, the line will be commenced next March.

Compound Winding Dynamos.—Under this title a small pamphlet, written by Mr. S. Alfred Varley, has been submitted to us. It is mainly compiled from the series of articles which that gentleman published in the REVIEW commencing in December last, and it is now brought out as the author's contribution to the general interests of the electrical industry at what he considers to be an important juncture, and he wishes it to be understood that he is entirely responsible for what appears in it as well as for its issue. The important juncture appears to be the pending lawsuit between Messrs. King, Brown & Co., of Edinburgh, and the Anglo-American Brush Coporation.

Electro-Harmonic Society's Opening Night.—The members of the Electro-Harmonic Society must have been gratified with the fare set before them on Friday evening last, and the originators of these enjoyable meetings must feel a great deal of pleasure in the knowledge that their efforts to entertain the members of the electrical profession should have turned out so eminently satisfactory. We cannot but think that the gathering to inaugurate the first concert of the 1888-89 season was the largest we have yet seen, and there are not wanting signs which indicate a more than usually successful series of meetings. The solo singing of Messrs. Arthur Thompson, W. G. Forington and Robert Hilton was in their most perfect style, and these admirable artistes, in conjunction with Mr James Brown, gave a number of part songs in a manner which could scarcely have been improved upon. Mons. Albert, a violoncellist of great repute, made his first appearance before the Electro-Harmonic Society, and his playing, which showed that he possessed a fine tone and most perfect intonation, gave great pleasure. Mr. Alfred Izard, whose accompaniments are always such a feature at any concert in which he appears, played a study of Liszt, showing to much advantage the beautiful piano which Messrs. Broadwood & Sons so courteously place at the disposal of the Electro-Harmonic Executive Committee. The next concert is to be a ladies' night, and the programme will be carried out by amateurs, amongst whom we have every reason to believe will be found Mrs. Alex. Siemens, Miss Edith Doughty, a young and promising violinist of some 14 summers, Mr. James Swinburne, Mr. Thomas Harrison and Mr. Stepney Rawson. Should any lady or gentleman be desirous of assisting either with song or instrumental selections, the musical directors will be glad to receive notification by an early post.

Searching for Projectiles in the Human Body by Electricity.—*Le Genie Civil* indicates as follows the means of seeking for projectiles in the human body by electricity. Prof. Graham Bell was the first to conceive the idea of determining the position of a projectile in the human body by the aid of the telephone. M. Schœntjes, a Belgian electrician, afterwards applied himself to the question, and in 1885 drew up the following particulars :—To one of the ends of a telephone wire he attached a needle covered with an insulating coat ; to the other a metallic plate. To proceed to the investigation the metallic plate was applied to the skin and the needle directed towards the part in which it was suspected the projectile would be found, care being taken not to injure any of the organs. Under these circumstances, if the investigating needle touch the metal, the telephone speaks ; it remains silent when the needle touches a bone or a cartilage. It is thus that one can discover whether the charges in explosive apparatus are in a good condition or not. M. Schœntjes has recently still further improved his process. He has recognised—1, that it was useless to cover the exploring needle with an insulating varnish ; 2, that the metallic plate, which was difficult to handle, is best replaced by a fine sewing needle ; 3, that instead of holding the needle on the surface of the body it was easier and more practicable, without inflicting any suffering on the patient, to fix it in the epidermis. In the case of an open wound, the ordinary metallic probe is replaced most perfectly by the needle. The metallic probe and the telephone also advantageously take the place of the probe, by means of which the celebrated surgeon, Nélaton, acquired, at the beginning of his career, so high a reputation.

Sprague Electric Railway and Motor Company.—We are requested by Mr. Frederic Nell, of 16, Mark Lane, who is well known as the representative of the "Victor" turbine, to announce that he has been appointed by the Sprague Electric Railway and Motor Company its European representative, and to intimate that he is prepared to attend promptly and courteously to all enquiries.

Electrical Tramways in France.—Some experiments with E.P.S. accumulators have lately been made in Paris as to the utilisation of electrical traction of tramways, and already the regular working of the Neuilly line by this means is spoken of. Some particulars as to the electric tramway, Vevey-Montreux-Chillon, are also to hand as follows :—The partial working of this tramway began in June. Up to August 11th the service was carried on with three carriages only, one carriage leaving in each direction every hour. On August 12th a service with four carriages was begun, one departing in each direction every 40 minutes. Soon the service is to be doubled, a carriage leaving every 20 minutes. A few days since a trial trip was made on the Tevritet-Chillon branch, and was so successful that the immediate opening of the line for traffic was decided upon. Up to August 31st, or 84 days, the tramway carried 81,652 passengers and earned 18,011f. 65c. The following are the particulars of the working :—

	June.	
23 days :	17,871 passengers	3,698 f. 15 c.
Per day :	777 = 160 f. 79 c.	
	July.	
30 days :	24,255 passengers	5,409 f.
Per day :	809 = 180 f. 30 c.	
	August.	
11 days :	9,675 passengers	2,183 f. 45 c.
Per day :	879 = 198 f. 36 c.	
	August (12—31).	
20 days :	29,871 passengers	6,722 f. 05 c.
Per day :	1,492 = 336 f. 10 c.	
	Total	18,011 f. 64 c.

To Avoid Confusion.—We are requested by Mr. A. A. Campbell-Swinton to state that his appointment as consulting electrical engineer to Messrs. Sir W. G. Armstrong, Mitchell & Co., of Elswick, which we mentioned last week, in no way affects his position as manager of the Equitable Telephone Association, which position he will still retain.

Magneto Bells on Board Ship.—The Equitable Telephone Association is fitting a number of their Cox-Walker-Swinton patent magneto-electric bells on board the war ship *Piedmonte*, now building on the Tyne for the Royal Italian Navy. The absence of any batteries in this system is expected to prove a great advantage for electric bell installations on board ship.

NEW COMPANY REGISTERED.

South African Lighting Association, Limited.—Objects : To supply gas, electric or any other artificial light in Port Elizabeth, King William's Town and elsewhere in South Africa. Signatories (with 1 share each), W. Cash, 90, Cannon Street ; E. K. Blyth, 112, Gresham House ; A. L. Don, Stourbridge, Willesden ; *D. F. Goddard, C.E., Ipswich ; S. Cutler, 11, Vanburgh Park, Blackheath ; C. Woodhall, C.E., Palace Chambers, Westminster ; J. L. Cloudsley, Stourbridge Park, Willesden. The first directors are D. Ford Goddard, J. Mansergh, and Wm. Woodall, M.P. Qualification—50 shares, or £500 stock. Minimum remuneration, £250 per annum. Registered 27th ult., by Wilkins, Blyth and Dutton, 112, Gresham House, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

United Telephone of Rosario, Limited.—The annual return of this company, made up to the 15th ult., was filed on the 24th ult. The nominal capital is £20,000 in £10 shares, the whole of which are taken up. No call has been made, but the shares are credited as fully paid up.

Crossley Telephone Company, Limited.—The annual return of this company, made up to the 24th ult., was filed on the 29th ult. The nominal capital is £100,000, divided into 5,000 A, 12,500 B, and 2,500 C shares of £5 each. 607 A, 120 B, and 350 C shares have been taken up, and calls of £5 have been made upon the A and C shares, and £1 upon the B shares. The calls paid amount to £4,905.

Telpherage Company, Limited.—The annual return of this company is made up to the 6th June. The nominal capital is £50,000 divided into 2,500 A and 2,500 B shares of £10 each. 1,616 A and 1,602 B shares have been taken up and the full amount has been called thereon. The calls paid amount to £16,022 10s., and considered as paid on B shares to £16,020. The calls unpaid amount to £137 10s. The sum of £362 10s. has been paid upon 50 shares forfeited.

Byng Telephone Company, Limited.—The annual return of this company is made up to the 11th April. The nominal capital is £5,000 in £10 shares. 207 shares have been allotted and £8 per share has been called up. The calls paid amount to £1,643 5s. and unpaid to £12 15s.

Welsbach and Williams, Limited (Manufacturing Chemists, Incandescent Light Manufacturers and Electricians).—The annual return of this company is made up to the 14th August. The nominal capital is £40,000 in £1 shares. 20,000 shares are taken up and the full amount has been called thereon. 10,000 shares are considered as paid up, and the sum of £10,000 has been received in payment of the remaining allotted shares.

Kay Brothers, Limited (Electrical, Chemical and Scientific Apparatus Manufacturers).—The annual return of this company is made up to the 23rd May. The nominal capital is £100,000 divided into 9,900 ordinary shares of £10 each and 100 founders' shares of £1 each. The shares taken up are 7,120 ordinary and 100 founders', and upon these £71,300 is considered as paid up.

CITY NOTES, REPORTS, MEETINGS, &c.

Edison and Swan United Electric Light Company, Limited.

THE annual general meeting of this company was held on Tuesday at the City Terminus Hotel, Cannon Street, the Chairman (Mr. James Staats Forbes) presiding.

Major S. Flood Page, the secretary, having read the notice convening the meeting, and the report of the directors having been taken as read,

The Chairman began by referring to the figures of the balance sheet, and the profit and loss account; dealing first with the debit side of the former, which left, as far as substantials were concerned, no change whatever. It showed that the subscribed capital was exactly as it had been; but there had been an alteration in the method of stating it in the account, and there was a printer's error—a reference to 5,000 A shares of £5 each, fully paid, allotted to the Edison and Swan United Electric Light Company. It should have said there were 5,000 shares—all being fully paid—allotted to the Edison Company. This was a part of the purchase of the Edison concern; and the next entry, of 12,139 A shares of £5 each, fully paid, allotted to the Swan United Electric Company, was part of the purchase of the Swan concern. There were sundry credit balances, and what they owed their creditors was £10,214 2s. 7d., as compared with £5,799 6s. 2d. last year, so that they were in debt a little more; but they need not be alarmed about that, because the volume of their business on the year had been considerably greater than in the preceding year. And when they came to the other side of the balance sheet they would find that, whereas they were somewhat more in debt, they had a much larger amount of good debts due to them. The profit and loss account for the year showed a credit balance of £25,123 9s. 7d. against £16,221 in the preceding year. On the other side of the account the cost of patents, goodwill, preliminary outlay, loss on working, as per last balance sheet, was £300,814 2s. 9d. Further expenditure thereon—£3,213 18s. 8d. —brought that amount up to £304,028; but they had been enabled during the year to get rid of some bad bargains which came over to them in the union of the two companies, by the sale of some plant to the extent of £12,790, which, of course, was a credit item in the shape of diminution. Then there was another item embraced by the general description three hundred odd thousand pounds loss on working. Honourable proprietors would remember that in the earlier years of their work, instead of showing a sheet of losses they determined that those losses of the earlier years must be redeemed out of the profits of later years until they disappeared. Happily, now they had disappeared, through diminishing the item from year to year by the profits made, and there was £25,000 profit in the present balance-sheet, free of all claim of that kind. They were on their legs, therefore, as a money-earning concern. After referring to various items in the accounts, the chairman alluded to the stock, and said: That enables me to call your attention to the fact that the stock brought forward last year on July 1st was only £12,868 in value, whereas the stock carried forward in the current year was £19,590, and that, you will see, bears some proportion to the increased business done; and it arises from what I explained, I think pretty fully, last year, that this business cannot be carried on without a very large reserve of manufactured lamps in stock. A great number of varieties of lamps, to suit the wants of different purchasers, must always be on hand; therefore you must end the year with a considerable number in stock to meet demands that may come upon you from day to day. If the sale of lamps in the year had remained stationary, while the stock carried forward had increased greatly, it would have been an ill sign; but as it really bears about the same proportion to the stock carried forward last year that the increased volume of business bears to the business of last year, I think it is about the right proportion; and the lamps, I need hardly tell you, are put down at approximately cost price. Now, gentlemen, that is the whole story of the accounts, and that is all the story I shall have to tell upon matters of account, for I wish to come to the question of this balance of £25,123. Now, supposing we were absolutely free of all legal questions, there is no doubt whatever that on the working of our business for the year we have honestly earned a profit of £25,000, after charging the concern with every proper outlay, and being somewhat liberal in the case of ordinary depreciation of plant and so forth. But, having left you there, I will now go to the report, because I have exhausted paragraph 2 by dealing with the accounts. That paragraph is very brief; it says: "The sale of lamps has progressed in a satisfactory manner during the year. The volume of the company's business has increased, and has resulted in a credit balance of £25,123 9s. 7d." This time last year, we were living in the belief that our patents were not only decided on appeal in the action of Woodhouse and Rawson, but were invulnerable. Well, since then our little illusion has been somewhat disturbed by the fact of an action brought by the Brush Company, in which the whole question of these patents had to be retried. Well, it is an illustration of the law of patents, that whilst Mr. Justice Kay's decision upon the Cheesbrough patent confirmed the decision already given in the Woodhouse and Rawson suit, his opinion of the Edison patent was different from that of the courts, both of first instance and appeal, for that he has declared to be invalid. Well, there it is; the Cheesbrough is declared again to be a valid patent, whilst the Edison patent is declared to be invalid. That is the decision of Mr. Justice Kay. Well, our learned friends, the great technical lawyers, whose minds are impregnated with all the history of this matter, and our technical advisers tell us that Mr. Justice Kay is very wrong. Of course, on that opinion we are going to appeal, and I am not going to predict what the result of an appeal may be. I can only tell you what competent experts tell us—that there is every probability that Mr. Justice Kay's decision on that point will be reversed. Well, I hope it will, although I am bound to say I do not think it a matter of primary importance that it should be, seeing that the Cheesbrough patent has been confirmed. We shall soon know, because I suppose that matter is coming on within a month. I see we promise the appeal shall be settled before Christmas, and if it is settled in our favour, I daresay we shall eat our Christmas dinner with a little more hilarity than if it is not. But whether it is or no, it will not, I fancy, have anything like a disastrous effect upon the future of this company. Well, then, the American Brush Company brought actions on two subjects. Very little importance attached to the first one, and as to the second—well, in matters of patents, who can tell? Anybody who wants to know the enormous dangers which are inherent in patents can read the proceedings of these two actions. I do not know how it may come out, but we are bound, if people bring actions, to defend them, and our legal advisers tell us we need not be in a state of alarm. I suppose those actions will proceed. Now, we are face to face with a profit legitimately made on the operations of the year, but with indefinite liabilities as to costs, in consequence of these actions. Well, I don't want to alarm anybody, because I don't think myself, as a matter of personal opinion, there is much ground for alarm; but what I should like to impress upon the shareholders is this—the great imprudence and unwisdom of parting with the profits of the year until questions so vital have been settled; because you will see at once—although the ultimate consequence of a decision against us on the Edison on appeal might, in our going concern, not be of great importance as lampmakers—the question of costs would be serious. Instead of having costs to receive we should have costs to pay, and I can tell you that costs to pay, in reference to patent actions, is about the most serious thing that you can face. I know a good deal about costs in different kinds of proceedings at law—Parliamentary amongst others—which are bad enough; but costs in patent actions are something awful. There may be a claim for damages. Well, our opponents are exceedingly ingenious people, and not more scrupulous, I suppose, than other people, and if their ingenuity can not only get the costs of the proceedings, but can land us in damages, I think it would be most unfortunate that we should have parted with the profit of the year, pending such questions. We have considered this with very

great care, with the assistance of our legal friends, and shall recommend the shareholders to carry that £25,000 forward on to reserve and not to distribute it. Then we come to No. 7 paragraph—"Lord Thurlow's amendment of the Electric Lighting Act of 1883 is leading to a considerable development of electric lighting, and to a corresponding increase in the company's business." Well, of course, we have reduced our early aspirations to the humble rôle of lampmakers, and lamps cannot be burned without installations, and we are very delighted to see other people embarking their capital and energy in the installing work; and, of course, it is very gratifying to us that the legislation of 1882, which was disastrous in its results, by handicapping electric installations, should have been so far modified that an immediate stir in the development of electric lighting has followed the alteration of the Act. The chairman explained the change made, by which the period at the end of which authorities may resume the privilege of supplying the electric light, after conceding it to a company, is extended from 21 to 42 years, and pointed out that there was also an important modification in the terms upon which machinery would be taken over in that event. He said there was no doubt the amendment of the law would give an immediate impetus to the progress of this business. He noticed there had been an extraordinary installation going on at Deptford in connection with the London Electric Supply. He knew most of the people in it, knew there was plenty of money in it, and that there was some ability in it, and he saw that amongst other things predicted of it was, that between now and the winter of next year they would want 250,000 electric lamps. Well (the Chairman added), we know where they can get them. So do they, because they are some of our best customers, and that is one indication. I dare say that the prediction of 250,000 for that one company may be a little exaggerated; but it may be all taken as evidence of what I have said, that this electric lighting business is going on, and if we can maintain our patent, as we certainly can—but most of all, if we can maintain the character we have got of making the best practical lamp there is in the market, then, I think, we are very likely to participate, at all events, largely in this great progression. And, fortunately for us, our capital need not be enlarged, or materially enlarged, to enable us to meet the claims of the additional manufacture of these lamps. Now I think I have said nearly all I ought to say. The words of the report formed a text, and I have preached upon it, and I will now move the resolution: "That the report and accounts be received and adopted."

Mr. F. R. Leyland (deputy-chairman) seconded, adding his concurrence with the remarks of the chairman that it would be wise not to divide the balance until the questions were settled between themselves and the Brush Company.

The Chairman, in reply to Mr. Donovan, said this company held a certain number of the deferred shares of the Manchester company, and stood in the same position to them as Mr. Edison occupied towards this company. He would take it that the directors were authorised to carry forward the balance.

With this understanding the resolution was carried unanimously.

Mr. Forbes and Mr. Leyland were re-elected to the board, and the auditors (Messrs. Quilter, Welton & Co.) were reappointed.

The meeting then terminated with a vote of thanks to the chairman.

Brazilian Submarine Telegraph Company, Limited.

THE thirtieth ordinary general meeting of this company was held at Winchester House, Old Broad Street, E.C., on Wednesday, the Right Hon. Viscount Monck, chairman, presiding.

Mr. Richard Collett, the Secretary, having read the notice convening the meeting, and the minutes of the previous meeting having been confirmed, the directors' report, which appeared in the REVIEW last week, was taken as read.

The Chairman, in moving its adoption, said that they had had a good deal of repairing to do in the half year, the Lisbon-Vienna section and the Madeira-St. Vincent section having both given out. The faults had been repaired, and the cable now tested as well as on the first day it was laid down. These repairs had largely increased the expenses of the half year, the cost having been close upon £8,000. With that exception, the expenditure had been pretty much the same as in the previous half year. The expenditure at the stations was £793 greater than in the corresponding half of last year; that was made up of increase of salaries in consequence of long service, maintenance of landlines and a new cable tank in Madeira. The general expenses in London showed a decrease of £1,571. The income, he was happy to say, showed a growing increase. For the half year under review it had been £7,000 greater than in the previous half year, and between £8,000 and £9,000 greater than in the corresponding half of last year. Since the end of the half year with which the report dealt the receipts had continued to show an equal, if not a much larger, increase. Under those circumstances, the directors felt no hesitation in paying the usual dividend of 7 per cent. for the half year, and setting aside £30,000 to the reserve fund, which now amounted to £170,000. They had also paid off a considerable sum on the debentures, which were issued for the purpose of duplicating the cable, and he thought they might assume that in a very short time they would have paid for the whole of the duplication out of revenue by the redemption of the debentures. There were two subjects to which he desired to briefly allude. One was with reference to the African Direct Company, in which they had a considerable interest. They took that interest, as would be remembered, more as a defence against any intrusion of other people on their ground than as a pecuniary speculation. But he was happy to say that it was likely to turn out very favourably. The company now paid its expenses, and he hoped that in future it would be a source of gain to them, for there was a proposal for an alternative route on that side of Africa to the Cape which would increase the earning powers of the African Direct Company, and also tend to increase the traffic over their own lines. The other subject upon which he desired to speak was with reference to their position in Brazil: they had been negotiating for a long time with the view of strengthening their position there, but he was sorry to say that he was not yet able to announce the success of the negotiations. They were doing their best, and he asked for the continued confidence of the shareholders, for a settlement would not be rendered more easy by a public discussion of the subject. He concluded by moving the adoption of the report and accounts and the declaration of a dividend of 3s. per share, making with the interim dividend already paid a total dividend of 6 per cent. for the year ending June 30th, and also a bonus of 2s. per share in respect of the profits to June 30th, the said bonus to be free of income tax.

Sir James Anderson seconded the resolution.

Mr. Halse enquired if any of the investments of the company was in Brazilian Government stock.

Mr. Weaver asked if the directors considered £170,000 formed a sufficient reserve fund for a company of their standing, and whether the present prosperity of the company was due to any sudden change in the trade of South America, or to a general improvement in trade, which was likely to continue.

The Chairman said the prosperity of the company had been so gradually progressive that his own opinion was that it was derived from the general advance of commercial prosperity in South America. He did not think £170,000 was a sufficient reserve, and they were adding to it as fast as they could. They thought it wiser not to invest in Brazilian Government stock.

The resolution was then unanimously carried, after which Sir Thomas Fairbairn and Mr. H. D. Gooch were re-elected directors and the auditors, Mr. Henry Dever and Mr. John Gane, were reappointed, a vote of thanks closing the meeting.

Buckingham Electric Light and Power Supply Company, Limited.

A GENERAL meeting of the shareholders was held on Wednesday, October 17th, at Buckingham, Mr. A. C. Rogers presiding.

The Chairman said they had much upon which to congratulate themselves. They had forty shareholders, holding 858 shares, and the sum of 10s. had been paid on each share. They had ample capital for lighting the town by electricity. Several shops were already illuminated in this way, and the light was giving every satisfaction. Altogether, the scheme promised well to be a most successful undertaking. The following directors for the coming year were then elected unanimously:—Messrs. A. C. Rogers, J. W. Thorpe, A. Vyle, G. W. French, and H. Thorpe.

Some other formal business having been disposed of, Mr. W. Habgood, engineer to the company, supplied some interesting figures, intended to show the superiority of the electric light over gas, both as to cheapness of maintenance, and as to illuminating power. They could, according to his experience, and on the secondary battery system, supply the light at 6d. per unit, which is equivalent to gas at 3s. per 1,000 feet. There would be no escape or waste whatever, and the light would be perfectly safe. The company had over seventy applications for the electric light in Buckingham already, and several large orders had been received from outside; in fact, they had orders over the full capacity of their present machinery. They hoped to obtain additional assistance shortly, when the wiring would be carried on more expeditiously. As it was, he and his staff were trying their utmost to oblige all applicants.

Mr. H. Small said he had noticed that some towns had not hitherto had much reason to be satisfied with the electric lighting. He was therefore all the more pleased to see the success which was attending the company's works in Buckingham. He hoped they would continue to prosper.

The Chairman, in reply to the queries of some of the gentlemen present, said he had used the light in his house, when the dynamo was not going, and the current was supplied only from the accumulators, and was perfectly satisfied with the result. He hoped the time was not far distant when the public buildings of the town would be lighted by electricity.

At the request of the chairman, the machinery was set in motion, and the works thrown open for the inspection of the company.

The proceedings then terminated with a unanimous vote of thanks to the chairman.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending October 26th, 1888, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £4,289.

The Brazilian Submarine Telegraph Company, Limited. The traffic receipts for the week ending October 26th amounted to £5,151.

OVERHEAD AND UNDERGROUND WIRES IN NEW YORK.*

By DR. SCHUYLER S. WHEELER.

IT is my purpose, in as brief and concise a manner as possible, to give you some idea of the condition of the overhead and underground wires in the City of New York, and the means which are being adopted by the public authorities to bring about a better state of affairs than the one now and for some time existing.

In 1884, the Legislature of the State of New York enacted a law to the effect that electrical companies in the cities of New York and Brooklyn should place their conductors underground. The local authorities were expected to enforce this law, and the maintenance of electrical conductors overhead in these two cities after a certain day was declared to be unlawful.

Of course, the business of telephoning, telegraphing and electric lighting could not be disposed of so summarily, and before the day appointed upon which the maintenance of wires overhead was to become unlawful fell due, the Legislature enacted in 1885, a law providing for the establishment and organisation of a commission, the purpose and object of which was to provide a plan by which electrical conductors in the cities of New York and Brooklyn could be placed underground without interfering with the efficiency of the electrical service. By this law of 1885, it was provided that companies could submit to the commissions established in the twin cities, plans for placing their conductors underground, and should the said plans meet the approval of the commissioners, the companies submitting them could thereupon proceed to place their conductors underground according to these approved methods.

In 1885, the question of placing electrical conductors underground was very generally disputed, and no companies submitted plans to the commission within the required time. It thereupon became the duty of the commissioners of electrical subways to devise a method by which electrical conductors could be placed underground and to compel companies to carry out the work according to this method.

The subject was then comparatively new, the difficulty not fairly comprehended, and the different kinds of service, as well as the ways in which the wires might be put underground, were not even classified.

The result of the investigation made by the commission to ascertain by what method wires could best be placed underground in cities was that the commission had to listen to about 450 plans, many of them having nothing to do with the work to be accomplished, and many of them utterly absurd.

Notwithstanding the impression that underground wires were a common thing in other cities, especially abroad, nothing had been done that would serve as experience for this city. In many places wires had been laid underground singly, in pipes, in sewers and in cables; but no such piecemeal plan could be allowed in a city having more telephones, more telegraphs, more electric lights, and less available area, than any other spot in the world, in proportion to the amount of business going on. To be of any value, under such circumstances, a plan had to be found which would permit new wires being put in from time to time, almost without limit, without disturbing the pavements of streets, and of sufficient capacity to accommodate the large number of wires, for which a sufficient space underground could scarcely be found between the various obstructions already buried.

The difficulty of the problem, and the reason why the experience of other places are of so little value to us, will be seen when it is considered that the number of wires in a given space in New York, taking the average, is very much greater than in any other centre in the world.

The places between which these wires run, instead of being in an approximately circular area, as in the case of the three other leading electrical cities, are drawn out on a long and very narrow island, thus crowding the conductors together and increasing their length between points. In addition to the difficulty of a much greater amount of wire and less area to contain it, there is the great difference in rapidity of business, which makes it necessary to be able to put up and remove wires and instruments here more speedily than in the older cities.

The ground was so filled with gas, water and steam pipes, sewer and pneumatic despatch tubes, and their connecting boxes and man-holes, that it was impossible to find a straight course for a conduit or even a small number of ducts; and the repairs to these, which are continually going on, would make the wires specially liable to disturbance and injury. The earth is saturated with gases from the various pipes and this would collect in any open space, such as the subways would afford, destroying the insulation of the cables, suffocating the workmen, or causing explosions. In comparing wires with gas mains, it is sometimes said that the former are much more difficult to bury successfully than the latter, because the leakage does serious harm, while the leakage from the gas pipes is of no consequence. It is true that the loss from escaping gas does not cripple the gas companies' business at their present prices, but the gas fills the earth, gets into the electrical conduits, and there makes a very bad combination, for which electricity has to stand the whole blame. Indeed, if it were not for the gas, the underground wire problem would be easier, and very much more agreeable. On the other hand, when the electric current wanders off and melts the iron of the gas pipe, electricity again has to stand the blame, and thus there is not a fair distribution of the responsibility.

In order to treat the subject thoroughly, the board of electrical subways of the City of New York, investigated all the different systems in use in other cities, in connection with the many plans which were submitted for approval to be used in New York.

It was found that in Paris they are fortunate in having extraordinarily large sewers, through which (in the streets where the sewers run) all of the wires are laid, together with the water pipes. These sewers consist of a large arched passage with a flat floor, through the centre of which runs a deep trench or canal for the sewage. The flat pavement on either side of this forms a broad walk, over which the pipes and wires are suspended from the arched roof. A rail is laid on either side of the canal, and on the track so formed a car can travel carrying a drag which is used in cleaning the canal or sewer proper. In the streets which do not have these sewers the wires are strung upon the housetops.

The only other place which at that time furnished experience at all applicable to the problem here was London. But here there were and are now, practically, no arc lights at all, and therefore no circuits, there are extremely few incandescents, with no out-door circuits, the telephone is not used very extensively, and the wires of the telegraph are placed underground by the Government. The plan employed is what might be called the hand-hole "drawing-in" system, and consists of 5-inch cast iron pipes laid under the sidewalks and accessible through hand-holes or "flush boxes." These pipes are said (I do not know how correctly) to be loosely jointed for the purpose of admitting water to preserve the cables, which are of gutta-percha, the same as is used for submarine cables, and which deteriorate very rapidly when exposed to the air. In other words, they have learned by their experience with ocean cables, how to make insulation which will stand the water, so they try to convert the subway problem into the same kind of work. Conduits have been laid at a later date in other places.

In Brooklyn there are about 10 miles of Dorsett conduit, and about 4½ miles of a conduit consisting of a wooden box made of creosoted boards loosely put together, with narrower ones slid into grooves on the inside to form partitions. This duct, being loose and unstable, simply affords a means of keeping cables from touching each other and keeping them in place; and as creosote will dissolve rubber it is not a good place in which to put a rubber cable.

Another plan which has seen some slight use in Philadelphia is the Johnstone system. This consists of a broad, flat, cast iron duct, made in sections, about 6 feet long, and divided horizontally into an upper and a lower half or shell, so that a section can be removed and another substituted without cutting the wires already drawn into place. The duct is divided into a number of smaller ducts, for classifying the wires, by partitions consisting of long slabs of cast iron, which are slid into place in grooves cast in the inside of the outer shell. The feature of this system is the facility which it affords of introducing an outlet from the duct exactly opposite any lamp post or desired part of a building, by taking off the upper or lower half of a single section and putting in its place a new half section with a hole in it at the desired point, to which a branching elbow can be bolted.

This construction has been authorised for a distributing system in New York, on Broadway from 14th to 34th Streets, for arc lighting, &c. The work is now being prepared, and the system is, therefore, of some interest.

There goes with this style of conduit a man-hole formed of a bottom, a top, and a variable number of rings, or sleeves, placed upon each other so as to build up the height of the man-hole and permit of the ducts being run out at any depth to escape pipe obstructions, &c. One of these sleeves is split up into a number of panels bolted together, any one of which can be taken off to allow the ducts to be run out on either side at any angle.

All of the other plans by which wires have been put underground, except the Dorsett and other man-hole "drawing-in" systems used in this city, which will be described later, consist of nothing but the wire with covering buried in a trench, and are of no value beyond the taking care of their own particular wire.

Prominent among such plans may be mentioned the Edison tubes. This system, which has been extremely successful for its one kind of service, consists of heavy copper rods wound with rope, and laid in wrought iron pipes filled with an insulating compound composed of Trinidad asphaltum, rosin, paraffin, and linseed oil. This compound is run into the type when heated to about 300 degrees Fahrenheit, under considerable pressure, while an exhaust is applied to the other end for the purpose of drawing out all air bubbles. The ends of the tubes are then plugged with wood soaked in paraffin, leaving the coppers projecting.

The chief peculiarity of this system of conductors, and the feature which is, perhaps, most familiar to all, is the means of connecting up these lengths of tubing and conductors. The rods are connected by short pieces of copper cable terminating in suitable copper sleeves, which are soldered to the ends of the rods when in position, and the bow-shaped expansion joint so formed is covered with hot compound poured into a small cast iron coupling box, which is bolted on to the junction. The lines terminate at the street crossing in large cast iron boxes, like man-holes, where the rods are joined by heavy copper cables to a suitable connecting device near the top.

This plan is too expensive except for very heavy conductors, but serves admirably the requirements of incandescent lighting. In the early days of the system the thin pipes were greatly damaged by picks in digging around them and by outside disturbances. A slight blow from a pick would puncture the pipe,

* Read before the Convention of the National Electric Light Association at New York.

letting in a little water, which was liable in time to form an arc between the conductors, which would in turn burn the compound converting it into a conductor, and forming a cross. The greatest difficulty with these tubes was found to be that the insulator would be converted into carbon by the charring action of leaks at the slightest start.

Tubes of the same style, but containing a large cable of small wires, have been in successful use in carrying telephone wires out from the Twenty-first Street exchange in New York.

Another method somewhat similar is the Brooks system, which consists of wires covered with cotton and drawn through large iron pipes, which are afterwards filled with a heavy rosin oil, so as to prevent the water from entering. This oil is a good insulator.

The remaining plans are of a lower grade of mechanical construction, and consist of wires and cables of various kinds laid in troughs and covered with some protecting substance, usually tar or asphaltum.

Among these may be mentioned the few telephone and telegraph wires in Boston, made into a cable laid in a trough and covered with bitumen. A few telephone wires in New York and electric light wires in Pittsburgh are laid in the same way.

There are also innumerable places where cables of various kinds are laid directly in the earth, sometimes with a board covering to protect them from men with shovels. But none of these are of special interest to us, because, obviously, we cannot use them.

The result of the investigations of the commission were summed up in their second report, dated June 30th, 1886, as follows :—

"The principal systems of electrical subways may be divided, first, as to their material composition, and, second, as to their mechanical construction, and the manner in which the wires are placed in them.

"As to material composition, subways are,

"1. Of insulating material, such as wood, glass, concrete, &c.

"2. Of conducting material, such as iron.

"As to mechanical construction, subways are, generally speaking,

"1. Tunnel systems.

"2. 'Drawing-in' systems.

"3. Solid systems.

"4. 'Dropping-in' systems.

"5. Combined systems.

"Tunnel systems, or those where space is provided underground sufficient to allow the passage to and fro of men who place the wires within the subway, could be recommended, were unlimited time and money at the disposal of the commission; but the expense of such a system and the crying need of immediate action preclude the adoption of such a plan. If ever underground railroads become a feature of our city transportation, then, perhaps, the tunnel can be used for some of the future trunk line cables.

"In Paris, where the foundations of the city are honeycombed in all directions by large sewers, such a plan is practicable and admirable, but not to be thought of in New York.

"Drawing-in systems, or those where man-holes are provided in the streets, connected by tubes or pipes, through which the wires can be drawn, are next in prominence and convenience to tunnel systems.

"In Chicago there were seen in successful operation nearly 20 miles of conduits of the 'drawing-in and out' pattern of various materials, containing all kinds of wires, as follows:—

"Eight miles of the Dorsett system of concrete conduit divided into ducts, and containing in the separate ducts wires of the city telephone, telegraph and fire service, electric light wires, and wires of different telegraph companies.

"Four miles of the Johnstone system of iron conduit divided by metal shelves, and carrying the wires of the Postal Telegraph Company.

"One mile of 3-inch iron pipes, four in number, carrying the wires of the Western Union Telegraph Company.

"Three miles of iron pipes, carrying the wires of the Bankers and Merchants' Telegraph Company.

"In Philadelphia a comprehensive 'drawing-in' system of iron was seen, containing electric light and telephone and telegraph wires.

"In Boston some two miles of such "drawing-in' iron systems are in operation.

"In London 9,000 miles of wire are underground, bunched into cables and drawn into 3-inch iron pipes.

"Solid systems, or those where wires are permanently embedded in insulating material and incapable of being reached except by tearing up the streets and the insulation, have been found to work with more or less success. The commissioners saw several miles of this conduit in successful operation in Chicago by the telephone company there, where wires were buried in an asphalte or coal tar cement, laid in a wooden trough.

"Several miles of similar conduit are in use in Washington for electric lighting, and there are other instances of the successful operation of this description of conduit.

"In this city of New York there are several systems in use underground, each more or less satisfactory to those employing it.

"A prominent example is the Brooks system, used by the Metropolitan Telephone and Telegraph Company. It consists of an iron tube in which cotton-wrapped wires are drawn, and the tube filled with oil, the oil acting as an insulating medium. It is kept at a desired pressure—the tubes constantly full by means of a stand-pipe. They use a 2¼-inch iron pipe, and the system is cheap, costing less than $11 per mile of wire, because into such a pipe they can draw 300 telephone wires. Wires for telephone purposes, and those used in the American District and other call boxes, are of a very light intensity, and do not need as heavy insulation as do all other kinds, This system is claimed to give perfect satisfaction for telephone conductors.

"The Western Union Telegraph Company has many wires already down in this city, laid in 3-inch iron pipes, into which they draw cables manufactured from okonite or kerite insulation. These pipes are lead jointed, are laid in Broadway, and have man-holes occasionally for taking out the wire.

"To sum up as to the form of subway, and the manner in which the wires are to be placed in it:—

"We are convinced that from the standpoint of an electrician simply, it may be said that almost any plan or system can be *made* to work, from a single lead covered wire laid directly in the earth to a great tunnel upon whose walls the insulated conductors can be hung. Within certain broad limits any system is electrically practicable; retardation and induction can be overcome. It is only when we face in this city the mechanical engineering and chemical questions of interference with water pipes, gas pipes, and sewer pipes, of obstructions from vaults, or danger from steam pipes, of the action of sewer and illuminating gas, that the necessity for careful discrimination presents itself.

"In the future, when the uses of electricity become more general, and its nature better known, it may be that the City of New York will absolutely require a grand electrical underground highway, where space can be provided for the conducting and distributing of sufficient power to run all the engines and work all the machinery within the city limits. It may be, and probably will be, that before such space is needed much more will be known of the qualities of different forms of electrical conductors, and of the best method of carrying them underground, and that the matter of electrical subways will be no longer experimental, but practically demonstrated in every detail.

"When such a time comes the commission or other authority will determine what is required to meet the necessities of the occasion.

"The responsibilities of the present commission begin and end with providing for the requirements of their own day, and for such of the exigencies of the future as they can reasonably anticipate.

"Leaving out of consideration all tunnel systems as too expensive, we must also discard any system which calls for the simple laying of insulated cables in the earth. They would not stand the chemical action of the gases and acids; the streets would be continually torn up for new connections and repairs. We are thus shut up to the question of electric subways or conduits, in which the wires or cables, insulated or otherwise, must be placed, and which once laid down should meet all the demands of the present and near future.

"Of conduits it may be safely predicted that, so far as the experience of this and other cities is a test, some form or other of a 'drawing-in' system is most convenient. The life of the best cable is by no means satisfactorily decided, and, of any particular cable, to predict how long it would last would be purely speculative. Of wires not contained in cables it may be said that they are equally or more uncertain in their length of life and usefulness. At all events, for purposes of distribution it is desirable that the wires should be easily approached at frequent intervals, and the commission cannot countenance any plan that looks to the disturbance of pavements more than is absolutely necessary.

"It may be that through lines of wire could be better protected laid in permanent beds of insulating material, but a 'drawing-in' conduit system allows space to be provided for new wires without the frequent tearing up of pavements.

"The commission can, therefore, give their approval to a 'drawing-in' system with frequent man-holes, as the general form of subway best adapted to meet the requirements of the electrical service of the present."

Up to this time it was the general impression which had not been contradicted by experience, because there was none, that the conduits must be built of a non-conducting substance, and not of metal, because the latter would be liable to chafe through the insulation on the wire and cause a ground, and because the companies using the more delicate currents—particularly the telephone company—declared positively that the presence of the large mass of surrounding metal would interfere by induction with the working of their wires.

The best known plan at this time for building ducts of insulating material, and without the use of metallic tubes, was the Dorsett system, which had been laid to some extent in Chicago.

This consists of a bundle of parallel tubular ducts about two and a half inches in diameter, built of blocks formed of a combination of coal tar, pitch and fine gravel, cast with tubular openings running through them from end to end. These blocks were placed together, end to end, with the holes in line so as to form continuous tubes or passages, and were cemented together by pouring a mastic, softer than was used in making the blocks, into the cracks between them. The blocks were made to adhere to this by warming their ends with hot irons and allowing them to cool after the mastic was poured in. To prevent the melted mastic from closing the ends of the passages, tubular pieces of metal or paper were inserted in the ducts at the ends of the blocks, making a sort of internal sleeve coupling. The conduits so formed terminate in brick man-holes at the street crossings.

The objections to this material, as it was afterwards found, are that it is brittle, porous, requires care in laying, and, having no elasticity, cracks with changes of temperature, so that it is not likely to be made water-tight with average workmanship.

But a conduit was laid in New York according to this plan, on Sixth Avenue, from Twenty-third to Fifty-eighth Streets, a distance of 1·6 miles. And the objections were then found, as far as arc circuits were concerned, that its numerous joints were liable to open, and it might leak as indicated above.

The next plan proposed for New York was to use a somewhat similar mixture without requiring it to be made so hard, with the object of preventing its cracking, and to preserve the openings or ducts by casting this bituminous mastic, or mixture of bitumen and sand, around long pasteboard tubes. But no tubes could be found which would not absorb moisture, and the heat of the mastic caused the tubes tried to swell up and disintegrate. The manufacturers of indurated fibre wares were confident that satisfactory tubes could be produced, but it required special machinery and a long time for experiments. Tin and sheet iron linings were then suggested, but objected to, on account of the difficulty of making good joints. Zinc, however, was considered unobjectionable, and an experimental duct of the Averil system, consisting of soldered zinc tubes in bituminous mastic was laid in the yard of one of the manufacturers; but it was found that the heat of the mastic melted the solder of the tubes. This difficulty was met by substituting a lap or foldover-seam, and then it was found that the heat of the mastic also affected the nature of the zinc, impairing its durability. On account of the certainty of the zinc tubing rusting and finally crumbling away, it was next thought best to insure the permanence of the bore of the ducts by substituting for the soft mastic some substance which would set, after being poured in, and become hard and durable. For this purpose a hydraulic cement concrete filling was substituted for the mastic. And then a line was laid in Fifty-eighth Street. In laying, the thin zinc tubing was found very frail, liable to be dented in handling, and therefore undesirable. But it was thought that the concrete would maintain a hard solid, smooth bore, even after the thin sheet metal lining had rusted out.

After a thorough investigation and discussion of all the different materials, and the advantages and disadvantages of each, it was finally concluded that a conduit or subway for electrical conductors, was merely a mechanical protection for the wires to be placed therein and should afford the very best protection possible to be procured, while the electrical protection or insulation might safely be left to the manufacturers of cables and wires to be placed in subways.

It was decided that the use of metallic tubes would not seriously interfere, by induction, with the working of the wires, and were to be preferred because the continuous conducting shield so formed will carry off any escaping current and prevent damage to other cables. Accordingly, conduits of iron gas pipe embedded in concrete were put down, and these seem to be about the best kind so far constructed. They are best, first because there are plenty of workmen who understand gas pipe fitting and laying concrete, and because they are durable and entirely noncombustible. The purpose of the cement is to prevent the iron from rusting, which it does very effectually. If in time the pipes are destroyed by rusting from the inside, the solid hydraulic cement concrete will remain, furnishing a permanent duct with a hard smooth bore.

The man-holes used in connection with these various kinds of ducts have nearly all been built of brick laid in hydraulic cement, and capped with an iron casting to form a seat for the water-tight lid. The lids are bolted down upon a rubber gasket; but, unlike the Edison lids—held by several screws—they are secured by a single thrusting screw, which, passing through a cross bar presses down upon the centre of the cover. Some of the lids have been made funnel-shaped, so as to cause water to drain away from the edge and collect in the centre. By this means, the liability to leakage at the gasket is diminished, because there is less chance of water standing over the joint. The facility of opening the man-holes afforded by this method of fastening the lid with a single screw, is of great value in reducing the labour and time required to open and close a line of conduit when laying a wire, and is a material advance in the solution of the problem.

In regard to moisture in the conduits: in the iron tube plan which is the best, there is of course no leakage, because the tubes themselves are water-tight, could even be made air-tight, and because they are covered with cement which is in itself water-tight. The man-holes are made of water-tight materials, and there should be no leakage under the lid. Lookers-on find that a great many of the man-holes have a great deal of water standing in them; this is simply because the lids are not fastened down, but simply laid in place by the builders, often without any gasket, and the man-holes fill with rain and stay full until cleaned out for use. When cleaned and closed properly, they appear not to receive any water by leakage. To satisfy myself of this, I had an ordinary brick man-hole, which had been thoroughly cleaned and dried by letting the sunshine in, on a bright day, marked on the inside with lime all the way round under the cover and then closed. This marking was to show whether any water came through the joint of the cover, in which case it would have run down over the lime mark and discoloured it, or whether it soaked in through the bottom or sides. But after a rainfall sufficiently heavy to test the leakage, the hole was opened and found perfectly dry and the lime undisturbed. This proved that there was leakage neither through the brickwork nor under the cover.

There is, however, another source of moisture, difficult to overcome, viz., the condensation of vapour from the air which the man-hole and ducts contain. Every time a hole is opened, it refills itself with warm air, containing more moisture than it can keep when cooled down to the temperature of the masonry, consequently as soon as the lid is screwed down, this fresh air deposits a dew on the inside of the man-hole. As it is impossible to open and dry out a man-hole without letting in new air which will condense in turn, no amount of cleaning will overcome this difficulty. The presence of moisture tends to corrode exposed wires; and, therefore, the question of whether it is better to protect the splices and make the insulation of the wires so that they will not be injured by this moisture, or to dry out the entire system of conduits by a system of ventilation is unsettled. But this question fortunately is one of minor importance.

The question of distribution of electrical currents from the main subways constructed in the manner I have described, has been largely left by the authorities in the City of New York to the preference of the electrical companies.

Two systems of distribution are at present actually in use in New York by the telephone company. These are known as the house-top system of distribution, an example of which may be seen at Sixth Avenue and 51st Street, and the hand-hole system of distribution, which may be seen at Broadway and Exchange Place.

In addition to these systems, there are five modes of distribution which can be readily applied to the subways as constructed in New York, and which will be allowed in cases where they are severally most expedient—the lamp post system of distribution, the house front system, the house vault system, now in use in Chicago, the back yard system, and the man-hole system. In the heart of Chicago, the distribution question is peculiarly easy of solution, because the sidewalks were left hollow by raising the street levels after the great fire, and the wires are run through these spaces to the houses.

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"Electrician of the Board of Electrical Control.

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"The number of miles of single wire conductors in New York city of the various kinds is as follows:—

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It will be seen from this that there are already underground in the City of New York more electrical conductors than in any other city in the world (except Paris), while the capacity of the construction already finished in this city may be estimated fairly at something over 30,000 miles of conductors.

There are through lines completed from the Battery to the Park on the two principal thoroughfares of this city, Broadway and Sixth Avenue, and a gradual conversion of overhead lines to underground lines in the busy parts of the city may be confidently expected.

The Board of Electrical Control is not unmindful, however, of the magnitude of the labour and expense required in converting the present arrangements into underground systems, and does not contemplate either the hampering of the business of electrical companies by forcing unreasonable numbers of wires underground, or by attempting to compel the use of subways faster than is consistent with the efficiency of the various electric service to the public. If the great mass of overhead conductors are removed, and the remainder of the service brought to a condition which will ensure the safety of the public, and, at the same time, the benefit of the companies themselves, it will be the result desired by the people of the city, and which the Board of Electrical Control is endeavouring to attain.

As to this matter of regulating the overhead service in the city, I may say that an investigation of all the wires overhead, instituted since I have been connected with the work of the authorities in charge of electrical matters here, by the inspectors appointed after a rigid examination and found competent for the purpose, has shown that a great deal of very bad and unnecessarily dangerous work has been done in New York, and that a reprehensible and inexcusable condition of overhead wires is the principal, if not the only, cause of the clamour for underground service.

In addition to this, an enormous quantity of wire and a large number of poles not in use at all exist, amounting, as has been variously estimated, to from a half to two-thirds of all the wire and poles in the city.

As I have said, a system of inspection and reports has been organised, and within a few months there have been found and reported to the owners 2,000 dead wires and other objectionable things described in the enclosed schedule, which explains itself. A notice is sent out in every case; at the end of a week the work is again inspected, and if nothing has been done the owner is again notified, and if the wires, poles, &c., are not necessary a notice is also sent to the Bureau of Encumbrances of the Department of Public Works to remove them.

All arc lamps that are so low as to be within the reach of a pedestrian with an umbrella are reported as too low. Circuits which have especially defective insulation or joints are reported as dangerous. A few cases of bad indoor work have been reported as violating the rules of the Board of Fire Underwriters, and so on. The number of complaints sent to the various companies, as well as the proportion of them that receive attention by each company, are shown in the detailed schedule, which indicates the position taken toward the work of inspection by the several companies, and I may say that the contumacious company of which I have already spoken is the only one which disregards the notification of flagrant bad work, for which there is no excuse, and which everyone else admits should be inspected on behalf of the public and corrected immediately.

One has no idea of the aerial freebooting that is and always has been going on with overhead wires until he spends some time seeing what there is overhead. The condition of wires in this city is simply outrageous. Every other kind of business, such as those which involve obstructing the sidewalks, have fallen under the supervision of some branch of the Government, and cleanliness and order have been insisted upon; but heretofore there has never been any supervision of out-door wiring, and its condition corresponds to that of a city without police supervision.

The companies owning wires will not permit each other to make common use of the poles, but will chop off wires owned by others without notice. The telephone people object to the electric light wires on account of the induction. Where there is a line of light wires on their side of the street passing close to their poles they will not allow them to be made fast. The result of the necessity thus made for extra poles is sometimes four lines of poles on one side of the street, hence most of the wires swing close to or against the other poles to which they are not attached, and linemen in climbing them have to crawl through all the other wires which are not fastened to cross-arms.

Among the cases of dangerous wires and unnecessary obstructions found by the inspectors, are full lines of large poles extending over miles of streets, filled with wires which are "open" and out of use, but left standing to save the expense of removal; long lines of poles left standing to preserve right of way; arc light day circuits within reach and with the insulation dropping off, and bunches of dead wires hanging from house tops, &c.

All of the work of inspection done by this department is such as is necessary for improving the condition of overhead electrical work and removing fixtures, &c., that are absolutely dangerous and objectionable.

For the purpose of the various legal proceedings which are being carried on to compel the most objectionable arc light company to make a start in placing their wires underground, the other principal companies having proceeded voluntarily, the pole line on 25th

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Detail of all Notices of Violations of Rules and Regulations sent, from June 14th to August 24th, 1888.

Name of company and nature of violation.	No. of violations.	Notices sent.	2nd notice.	Notice answered.	Notice attended to.	Notice sent to Bureau of Incumbrances.	Notices Referred to board.
U.S. Illuminating Co.:							
Dead poles	113	38	10	2	...	4	...
Dead wires	283	173	52	29	20	46	...
Useless fixtures and wires	28	26	11	6	...	1	2
Lamps low	28	26	11	2	2	...	1
Wires not insulated ...	60	53	2	17	25	...	...
Dangerous poles ...	1	1	...	...	...	...	...
Total ...	513	317	86	56	47	51	3
Brush Electric Lighting Co.:							
Dead poles	42	14	2	1	4	4	...
Dead wires	34	27	3	16	11	3	...
Wires not insulated ...	30	29	10	6	12	...	...
Dangerous circuits ...	3	3	...	3	3	...	...
Slack wires	1	1	...	...	...	...	...
Total ...	110	74	15	26	29	7	...
Metropoltn. Telep.& Teleg.Co.:							
Dead wires	60	41	5	19	27	...	...
Dangerous poles... ...	1	1	...	...	...	...	...
Total ...	61	42	5	19	27	...	...
Fire Department:							
Dead wires	43	23	2	...	...	...	...
Dead poles	2	2	...	...	...	...	...
Dangerous poles... ...	2	2	...	...	...	...	...
Other violations... ...	2	2	...	...	...	...	...
Total ...	49	29	2	...	...	...	...
West. Union Telegraph Co.:							
Dead wires	69	41	3	2	13	2	...
Dead poles	6	5	...	...	1	...	...
Slack wires	1	1	...	...	...	...	...
Total ...	76	47	3	2	14	2	...
Mount Morris Elec. Light Co.:							
Lamps low	8	8	...	8	...	1	8
Total ...	8	8	...	8	...	1	8
East River Elec. Light Co.:							
Dead wires	13	11	...	...	...	...	...
Lamps low	2	2	...	...	...	...	...
Total ...	15	13	...	...	...	...	...
Daft Motor Power Co.:							
Dangerous circuit ...	1	1	...	...	...	...	...
Other violations... ...	1	1	...	...	...	...	...
Total ...	2	2	...	...	...	...	...
Postal Telegraph Co.:							
Dead wires	3	...	...	...	...	...	...
Dangerous poles ...	1	1	...	...	1	...	...
Total ...	4	1	...	...	1	...	...
American Dist. Teleg. Co.:							
Dead wires	14	8	1	...	2	...	...
Dangerous circuits ...	2	2	...	...	...	...	...
Total ...	16	10	1	...	2	...	...
Police Department:							
Dead wires	15	4	...	...	...	...	...
Dead poles	8	2	...	...	...	...	...
Total ...	23	6	...	...	...	...	...
Grand total ...	867	548	112	111	121	61	11

Notices sent to companies, as above	548
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	740

But a conduit was laid in New York according to this plan, on Sixth Avenue, from Twenty-third to Fifty-eighth Streets, a distance of 1·6 miles. And the objections were then found, as far as arc circuits were concerned, that its numerous joints were liable to open, and it might leak as indicated above.

The next plan proposed for New York was to use a somewhat similar mixture without requiring it to be made so hard, with the object of preventing its cracking, and to preserve the openings or ducts by casting this bituminous mastic, or mixture of bitumen and sand, around long pasteboard tubes. But no tubes could be found which would not absorb moisture, and the heat of the mastic caused the tubes tried to swell up and disintegrate. The manufacturers of indurated fibre wares were confident that satisfactory tubes could be produced, but it required special machinery and a long time for experiments. Tin and sheet iron linings were then suggested, but objected to, on account of the difficulty of making good joints. Zinc, however, was considered unobjectionable, and an experimental duct of the Averil system, consisting of soldered zinc tubes in bituminous mastic was laid in the yard of one of the manufacturers; but it was found that the heat of the mastic melted the solder of the tubes. This difficulty was met by substituting a lap or foldover-seam, and then it was found that the heat of the mastic also affected the nature of the zinc, impairing its durability. On account of the certainty of the zinc tubing rusting and finally crumbling away, it was next thought best to insure the permanence of the bore of the ducts by substituting for the soft mastic some substance which would set, after being poured in, and become hard and durable. For this purpose a hydraulic cement concrete filling was substituted for the mastic. And then a line was laid in Fifty-eighth Street. In laying, the thin zinc tubing was found very frail, liable to be dented in handling, and therefore undesirable. But it was thought that the concrete would maintain a hard solid, smooth bore, even after the thin sheet metal lining had rusted out.

After a thorough investigation and discussion of all the different materials, and the advantages and disadvantages of each, it was finally concluded that a conduit or subway for electrical conductors, was merely a mechanical protection for the wires to be placed therein and should afford the very best protection possible to be procured, while the electrical protection or insulation might safely be left to the manufacturers of cables and wires to be placed in subways.

It was decided that the use of metallic tubes would not seriously interfere, by induction, with the working of the wires, and were to be preferred because the continuous conducting shield so formed will carry off any escaping current and prevent damage to other cables. Accordingly, conduits of iron gas pipe embedded in concrete were put down, and these seem to be about the best kind so far constructed. They are best, first because there are plenty of workmen who understand gas pipe fitting and laying concrete, and because they are durable and entirely noncombustible. The purpose of the cement is to prevent the iron from rusting, which it does very effectually. If in time the pipes are destroyed by rusting from the inside, the solid hydraulic cement concrete will remain, furnishing a permanent duct with a hard smooth bore.

The man-holes used in connection with these various kinds of ducts have nearly all been built of brick laid in hydraulic cement, and capped with an iron casting to form a seat for the water-tight lid. The lids are bolted down upon a rubber gasket; but, unlike the Edison lids—held by several screws—they are secured by a single thrusting screw, which, passing through a cross bar presses down upon the centre of the cover. Some of the lids have been made funnel-shaped, so as to cause water to drain away from the edge and collect in the centre. By this means, the liability to leakage at the gasket is diminished, because there is less chance of water standing over the joint. The facility of opening the man-holes afforded by this method of fastening the lid with a single screw, is of great value in reducing the labour and time required to open and close a line of conduit when laying a wire, and is a material advance in the solution of the problem.

In regard to moisture in the conduits: in the iron tube plan which is the best, there is of course no leakage, because the tubes themselves are water-tight, could even be made air-tight, and because they are covered with cement which is in itself water-tight. The man-holes are made of water-tight materials, and there should be no leakage under the lid. Lookers-on find that a great many of the man-holes have a great deal of water standing in them; this is simply because the lids are not fastened down, but simply laid in place by the builders, often without any gasket, and the man-holes fill with rain and stay full until cleaned out for use. When cleaned and closed properly, they appear not to receive any water by leakage. To satisfy myself of this, I had an ordinary brick man-hole, which had been thoroughly cleaned and dried by letting the sunshine in, on a bright day, marked on the inside with lime all the way round under the cover and then closed. This marking was to show whether any water came through the joint of the cover, in which case it would have run down over the lime mark and discoloured it, or whether it soaked in through the bottom or sides. But after a rainfall sufficiently heavy to test the leakage, the hole was opened and found perfectly dry and the lime undisturbed. This proved that there was leakage neither through the brickwork nor under the cover.

There is, however, another source of moisture, difficult to overcome, viz., the condensation of vapour from the air which the man-hole and ducts contain. Every time a hole is opened, it refills itself with warm air, containing more moisture than it can keep when cooled down to the temperature of the masonry, consequently as soon as the lid is screwed down, this fresh air deposits a dew on the inside of the man-hole. As it is impossible to open and dry out a man-hole without letting in new air which will condense in turn, no amount of cleaning will overcome this difficulty. The presence of moisture tends to corrode exposed wires; and, therefore, the question of whether it is better to protect the splices and make the insulation of the wires so that they will not be injured by this moisture, or to dry out the entire system of conduits by a system of ventilation is unsettled. But this question fortunately is one of minor importance.

The question of distribution of electrical currents from the main subways constructed in the manner I have described, has been largely left by the authorities in the City of New York to the preference of the electrical companies.

Two systems of distribution are at present actually in use in New York by the telephone company. These are known as the house-top system of distribution, an example of which may be seen at Sixth Avenue and 51st Street, and the hand-hole system of distribution, which may be seen at Broadway and Exchange Place.

In addition to these systems, there are five modes of distribution which can be readily applied to the subways as constructed in New York, and which will be allowed in cases where they are severally most expedient—the lamp post system of distribution, the house front system, the house vault system, now in use in Chicago, the back yard system, and the man-hole system. In the heart of Chicago, the distribution question is peculiarly easy of solution, because the sidewalks were left hollow by raising the street levels after the great fire, and the wires are run through these spaces to the houses.

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As I have said, a system of inspection and reports has been organised, and within a few months there have been found and reported to the owners 2,000 dead wires and other objectionable things described in the enclosed schedule, which explains itself. A notice is sent out in every case; at the end of a week the work is again inspected, and if nothing has been done the owner is again notified, and if the wires, poles, &c., are not necessary a notice is also sent to the Bureau of Encumbrances of the Department of Public Works to remove them.

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Lamps low	28	26	11	2	2	...	1
Wires not insulated ...	60	53	2	17	25	...	...
Dangerous poles ...	1	1	...	...	...	...	...
Total ...	513	317	86	56	47	51	3
Brush Electric Lighting Co.:							
Dead poles	42	14	2	1	4	4	...
Dead wires	34	27	3	16	11	3	...
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Dead wires	60	41	5	19	27	...	...
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Total ...	61	42	5	19	27	...	...
Fire Department:							
Dead wires	43	23	2	...	...	...	...
Dead poles	2	2	...	...	...	...	...
Dangerous poles... ...	2	2	...	...	...	...	...
Other violations... ...	2	2	...	...	...	...	...
Total ...	49	29	2	...	...	...	...
West. Union Telegraph Co.:							
Dead wires	69	41	3	2	13	2	...
Dead poles	6	5	...	...	1	...	...
Slack wires	1	1	...	...	...	...	...
Total ...	76	47	3	2	14	2	...
Mount Morris Elec. Light Co.:							
Lamps low	8	8	...	8	...	1	8
Total ...	8	8	...	8	...	1	8
East River Elec. Light Co.:							
Dead wires	13	11	...	...	...	...	...
Lamps low	2	2	...	...	...	...	...
Total ...	15	13	...	...	...	...	...
Daft Motor Power Co.:							
Dangerous circuit ...	1	1	...	...	...	...	...
Other violations... ...	1	1	...	...	...	...	...
Total ...	2	2	...	...	...	...	...
Postal Telegraph Co.:							
Dead wires	3	...	...	...	...	...	...
Dangerous poles ...	1	1	...	...	1	...	...
Total ...	4	1	...	...	1	...	...
American Dist. Teleg. Co.:							
Dead wires	14	8	1	...	2	...	...
Dangerous circuits ...	2	2	...	...	...	...	...
Total ...	16	10	1	...	2	...	...
Police Department:							
Dead wires	15	4	...	...	...	...	...
Dead poles	8	2	...	...	...	...	...
Total ...	23	6	...	...	...	...	...
Grand total ...	867	548	112	111	121	61	11

Notices sent to companies, as above	548
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	740

Street from Broadway to Fifth Avenue was chosen for special complaint. The subways on this route which were specially provided for these lines have been finished for some time, and are dry and in good order. This line of overhead wires is in bad order, one of its stretches having no less than thirteen splices; and it is made still more liable to do damage by the presence of numerous dead wires which, not being required for use, are practically stored upon the cross-arms.

In conclusion, we may sum up the situation about as follows:—

The telegraph and telephone problem is practically solved. It is found necessary to resort to subways in order to get sufficient space for wires, and wires for this use are being drawn into the tubes as fast as the labour can be performed. There are about 4,000 miles of telephone and telegraph wire already underground, and 12,000 miles of cables about to be laid in the fall. It is estimated that the saving in cost of maintenance will be about $100,000 per year owing to the permanence of the kind of work which is possible underground.

The laying of electric light wires has not been so fully developed, and naturally none of the companies care to bear the expense of the first experiment. But after the initiative has been taken the difficulties will be overcome as they arise, as in the development of all other enterprises, and the underground system will become a settled and accepted fact.

Meanwhile, the lawless running of overhead wires is being stopped. All wires in a street must be run on a single line of poles. The dead wires and poles must not be stored in the streets, and all construction must be made under the supervision and control of some official in precisely the same way that other works which affect the public are carried on.

THE ELECTRIC LIGHT AT BATH.

AT last week's meeting of the Bath Corporation a voluminous report respecting the introduction of the electric light into Bath was presented by the Electric Lighting Committee. Under the terms of the original resolution sanctioning the installation in the city, Mr. H. G. Massingham's tender to supply arc lamps of 1,200 C.P. each, with overhead wires, at £18 17s. 6d. per lamp per annum for a term of seven years, was accepted under certain conditions. Mr. Massingham and two sureties for the due performance of the contract within the specified time (six months) undertook all responsibility, with the proviso that on the formation of a limited liability company, having a capital of not less than £10,000, the contractor should have power to assign the contract to the company, and thereupon his and his sureties' liability should cease. The committee were informed by Mr. Massingham that it was proposed to secure the Bathwick Mills as the centre of the electricity, as all the mains could be carried there without going over private property. Eighty-one lamps would be required, and it was necessary for the carrying of the mains and wires that 243 iron columns, each about 30 feet high, should be erected at an estimated cost of £2,500. This contingency was not provided for by the resolution of the Council, and the question had arisen how this sum should be dealt with. Under section 4 of the Electric Lighting Act the Board of Trade had power in all cases in which the electric light was introduced for public lighting otherwise than by a private Act of Parliament, a provisional order, or a license to the person using the light to require that the light should be used only in accordance with such conditions and subject to such regulations for the assurance of public safety as the Board of Trade might prescribe. The committee therefore considered the desirability or otherwise of altering the terms of the proposed contract so as to stipulate that Mr. Massingham should provide the columns upon receiving £3 per lamp per annum additional, making the charge per lamp £21 17s. 6d. instead of £18 17s. 6d. This was agreed to by Mr. Massingham, and the committee then inquired as to what terms should be offered to occupiers living within the area to be lighted. Mr. Massingham was of opinion that all occupiers whose premises were 30 feet from the electric mains should be supplied at a price not exceeding £2 per annum, payable quarterly in advance, for a lamp of 10 C.P. burning from dusk to midnight as the season of the year required, subject to the consumer having his premises properly wired and fitted with suitable lamps; occupiers could be supplied by meter, the meter to be approved by the urban sanitary authority at a rate not exceeding 1s. per Board of Trade unit. In conclusion, the committee recommended the proposed contract should be altered to the effect that the contractor supply the columns on being paid £21 17s. 6d. per lamp per year instead of £18 17s. 6d., and that Mr. Massingham should have the power to assign the contract to a company with a capital of £10,000, of which not less than £5,000 must be paid up. A discussion followed, in which it was pointed out that the electric light would constitute a capital advertisement for Bath, and would be a great seconder of the public peace. Eventually the resolution was carried with the addition of an amendment giving the Corporation power to buy the whole of the plant at the end of seven years at a fair valuation.

NEW PATENTS—1888.

15017. "An improved electrical indicator to show from which room or station a bell has been rung in domestic electric bell and telephone circuits." F. KENDALL. Dated October 19.

15030. "Improvements in combined steam engines and dynamo-electric machines." J. GWYNNE and C. F. COOPER. Dated October 19.

15102. "An improved system of and apparatus for electrically working hoisting machinery." A. L. FYFE. Dated October 20.

15104. "Improvements in electric meters." T. A. GARRETT and W. LUCAS. Dated October 20.

15105. "Improvements in fire-alarm telegraphs." H. F. W. LEWIS, H. A. C. SAUNDERS and A. C. BROWN. Dated October 20.

15129. "Maritime warfare, named or designated the 'Automatic electric messenger,' being an improvement in torpedoes, consisting of two horizontal thin tempered flexible steel fins to give greater stability and an increased speed." J. H. S. BRADLEY and J. H. WILSON. Dated October 20.

15130. "Maritime warfare, named or designated the 'Automatic electric messenger,' being an improvement in torpedoes, consisting of an automatic diving and floating rudder." J. H. S. BRADLEY and J. H. WILSON. Dated October 20.

15183. "Improvements in electrical telegraphs." E. EDWARDS. (Communicated by E. Cassalette and D. Kunhardt, Germany.) Dated October 22. (*Complete.*)

15206. "Improvements in apparatus for transmitting, telegraphic, indicating, or other analogous signals or movements." A. B. BROWN. Dated October 23.

15216. "Improvements in the construction of switches for the making and breaking of circuits conveying electric currents." C. M. DORMAN and R. A. SMITH. Dated October 23.

15237. "An improved process for the manufacture of akaline metals, such as aluminium, chromium, &c., by electrolysis and chemical reactions, and apparatus therefor." M. W. W. MACKIE. Dated October 23.

15249. "Improvements in dynamo-electrical machines." S. Z. DE FERRANTI. Dated October 23.

15252. "Improved machines for making battery plates." O. E. MADDEN and A. F. MADDEN. Dated October 23. (*Complete.*)

15369. "Improvements in secondary batteries." P. A. FICHET and A. NODON. Dated October 25. (*Complete.*)

15375. "Railway electric fog signalling apparatus." F. SIMPKIN. Dated October 25.

15388. "Improvements in apparatus for regulating dynamo-electric machines." A. SHIPPEY. (Communicated by A. G. Waterhouse, United States.) Dated October 25. (*Complete.*)

15394. "An improved electric miners' safety lamp." G. C. LEVEY. Dated October 25.

15395. "Improvements in instruments for measuring and regulating electric currents and differences of potential, partly applicable to telegraphic purposes." P. CARDEW. Dated October 25.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1887.

13720. "Apparatus for effecting electrical measurements and contacts." A. DE KHOTINSKY. Dated October 10. 4d. Claim:—In apparatus for effecting electrical measurements and contacts, the use of a conducting rod, bar, or plate included in an electrical circuit, and formed of two or more metals having different degree of expansion, the said rod, bar, or plate being connected at one point of its length to a fixed support, so that on passing an electric current through it the resulting unequal expansion of the two metals due to the heating will cause the end or ends thereof to move, which motion is either communicated to an index on a measuring scale, or caused to make or break an electrical contact, substantially as described.

15158. "Improvements relating to electric safety lamps." J. SINCLAIR and J. P. REES. Dated November 7. 8d. Is chiefly designed to facilitate the work and diminish the expense attending the use of safety lamps of the kind or class wherein an incandescent electric lamp of any suitable description is enclosed in a glass casing or lantern provided with contact pieces, one of which can be moved to and from the other, and is held in contact therewith by pressure in the said casing or lantern, a spring being combined with the said movable contact piece, so that should the said casing be broken and the said pressure removed, the said spring will expand and break contact between the said pieces, thereby interrupting the electric circuit and extinguishing the light. The claims are 3 in number.

15754. "Improvements in the electrolytes of secondary voltaic batteries. W. J. S. BARBER-STARKEY. Dated November 17. 6d. Consists in employing as an electrolyte in such batteries a solution of a sulphate or bisulphate of potash or of sulphate of magnesia alone or in combination in water or in dilute sulphuric acid, to which there may be added, if required, carbonate or bi-carbonate of the base or the bases and of ammonia. The claims are 2 in number.

15939. "Improved apparatus for the electrolytic treatment of sewage and other impure liquids." W. WEBSTER, jun. Dated November 19. 8d. Claim:—Arranging conduits for sewage or impure liquids, so as to act as electrolytic apparatus for precipitating and disinfecting the sewage or other liquid flowing through, by constructing the said conduits of separate insulated sections constituting positive and negative electrodes through which continuous or alternating currents from a generator of electricity are passed, substantially as described.

16087. "An electric contact maker, particularly applicable for use in conjunction with coin freed apparatus." J. S. FARMER. Dated November 23. 8d. The action of the contact maker is as follows:—When two glass bulbs are in a vertical position with metal pellets or equivalent in the lower bulb, the electric circuit will be broken, but by turning the contact maker on its pivots and reversing the position of the two bulbs, the pellets or equivalent will flow slowly from the upper bulb through the central passage into the lower bulb, thereby completing the electric circuit as they touch the two portions of the metal collar until all the pellets, or equivalent, have passed into the lower bulb. The claims are 3 in number.

18030. "Improvements in thermo-electric batteries." L. C. E. LEBIEZ and P. L. VERCHERE. Dated November 8. 8d. Claims:—1. In thermo-electric batteries, a negative element composed of nickel in conjunction with a positive composed of zinc and antimony, cadmium and antimony, or any other appropriate metal or alloy, substantially as specified. 2. In thermo-electric batteries, the mode of constructing the couples, which permits of heating the negative elements to any required degree without submitting to the action of the burner the points of contact of the two electrodes, which latter are thus heated by conduction, substantially as set forth and shown in the drawing. 3. In thermo-electric batteries of this or analogous description, the arrangement of binding wires on the negative insulators, in such a manner as to maintain the flow of the current in the event of rupture of one or more of the positive elements, substantially as and for the purposes set forth.

1888.

4221. "Improvements in the construction of holders for incandescent electric lamps." T. COAD. Dated March 19. 6d. The body of the holder is constructed of wood, vulcanite, or any suitable material, to which is attached a bent arm for the purpose of holding the lamp; in one end of the bent arm is formed an aperture, through which aperture the loops of the lamp pass, and are attached to suitable springs, one of the springs being insulated; in the opposite end of the bent arm or holder a slot is "preferably" formed for the purpose of adjusting the lamp to the required height and also for securing perfect contact, the arm is then clamped in position by a nut and screw or any suitable means. The holder is provided with two terminals, one of which is insulated from the lamp, the other is connected direct to the lamp by means of one of the springs mentioned above, the circuit is completed between the insulated terminal and the insulated spring by a screw or lever or other suitable means. The reflector is formed with an aperture concentric with that in the bent arm or holder and resting upon it, consequently the lamp is in proximity to the reflector and the light thereby intensified. There is 1 claim.

4659. "Improvements in apparatus for making and breaking electrical circuits in connection with call or alarm boxes and recording the same automatically on dials." F. T. SCHMIDT. Dated March 27. 8d. Relates to certain improvements in the apparatus described in specification No. 4,980, 1887, and has for its object the provision of means by which the district from whence an alarm has been sent is indicated at the central station by dial pointers operated either separately or in combination with a dial piercing needle; the apparatus being controlled in such a manner that, the tens and units comprising the number of the call box or district, are denoted by separate pointers on the same or different dials, and by the perforations of a needle in a revolving dial. The claims are 4 in number.

4759. "Improvements in and relating to telephonic apparatus." H. H. LAKE. (Communicated from abroad by International Dudley Signal Company, of America.) Dated March 28. 1s. 3d. This invention is embodied in a transmitter or instrument for governing the transmission of electric impulses over a circuit for the purpose of operating individual signalling instruments or other apparatus of a similar nature. The claims are 11 in number.

7805. "Improvements in the method of and apparatus for the production, transmission, and distribution of electric currents." H. J. ALLISON. (Communicated from abroad by C. E. Fritts, of New York.) Dated May 29. 11d. In this system, if the circuit is accidentally broken, only the apparatus near the break is partially disabled, all the others on the circuit continuing to operate perfectly. Another advantage is that an open circuit does not disable the generator (if a dynamo-electric machine), as is usually the case. The system also has the advantage of economy in the cost of producing and distributing electricity, by repeated inductions, instead of sending the currents bodily over the entire length of the circuit; to render consumers independent of the original generator as regards the character of the current they use, by giving them the power to take off a current of any potential or strength they require, within the capacity of the generator without interfering with other consumers. The claims are 49 in number.

7848. "Improvements in or relating to indicators for alternating electric currents." W. P. THOMPSON. (A communication from abroad by G. Westinghouse, jun., of America.) Dated May 29. 8d. The invention consists in introducing into the circuit of the voltmeter an opposing electromotive force, the amount of which is proportional to the current delivered to the work-circuit, and therefore approximately proportional to the fall of potential in transmission. The claims are 11 in number.

7849. "Improvements in or relating to apparatus for detecting and locating faults in alternate current electric circuits." W. P. THOMPSON. (A communication from abroad by G. Westinghouse, jun., of America.) Dated May 29. 8d. Consists generally in placing two electric converters in circuits which may be completed from the respective poles of a generator or lines leading therefrom, with the earth, and in applying to each an indicating device, such for instance as an incandescent electric lamp, included in their respective secondary circuits. In case there is a ground connection with one of the lines, the converter connected with the corresponding line will be short-circuited, and the consequent variation in the light operated by the converter will indicate that such false connection is made. The claims are 3 in number.

7852. "Improvements in or relating to central station apparatus for system of electric distribution by alternate currents." W. P. THOMPSON. (A communication from abroad by G. Westinghouse, of America.) Dated May 29. 8d. The invention consists generally in organising apparatus in substantially the following manner. A suitable number of dynamo-electric generators are employed, say four; these have their field magnets supplied by currents from two separate exciters, each provided with its own driving engine. The field magnets are connected in multiple arc with their respective exciters, and the generators are independently regulated. The exciters may be of such capacity that either one may serve to supply the currents necessary for the entire system of alternate current generators. Suitable switch and circuit-controlling devices are employed for connecting the exciting generators in multiple arc with each other, for the purpose of supplanting either one by the other. The several alternate current generators are connected with their work circuits in multiple arc or parallel circuit, and each has its own ammeter and voltmeter for determining the current. Each alternate current generator is provided with a switch whereby it may be thrown into and out of circuit, and each has a double pole or two-way switch for connecting with either of two sets of feeders or main lines. Preferably, also, each generator is provided with a single light connected in the secondary circuit of a converter, the primary of which is connected across the poles of the generator, and this light is used as an indicator or pilot light. The distributing wires leading to the work circuits are connected with the trunk wires through suitable double-pole switches. The claims are 10 in number.

7998. "Improvements in and relating to shades and reflectors for incandescent electric lamps." F. HOLMAN. Dated May 31. 8d. The inventor constructs the improved shade with a conical or approximately conical body portion of sheet metal, or other suitable material, of sufficient strength, and which is not liable to be broken, and a disc of glass or other transparent or translucent material, said disc being adapted to be fitted against the larger end of the body portion and detachably secured thereto by suitable catches or fastenings. The conical body portion is preferably rendered reflective by making its inner surface of bright polished metal or other reflecting material. He also provides an auxiliary shade or screen adapted to be applied at one side of the body portion of the reflector, and to be adjusted at various angles, in order to screen the light of the lamp from the eyes of the person using it, or allow the full reflection of the light. The claims are 11 in number.

8223. "A magnetic separator for extracting ferruginous matters from ores and other material." A. H. REED. (Communicated from abroad by G. Conkling, of America.) Dated June 5. 6d. Claims:—1. The combination with a primary apron of a secondary apron made to operate transversely to the primary apron, a magnetised plate secured in proximity to said secondary apron, so as to draw the iron particles to said secondary apron, and suitable driving mechanism for actuating the aprons, substantially as set forth. 2. The combination with a primary apron and a secondary apron made to operate transversely to the primary apron of a magnetised plate secured in proximity to said secondary apron, so as to draw the iron particles to said secondary apron, suitable driving mechanism for actuating the aprons, and a scraper or brush made to act on said secondary apron, substantially as set forth. 3. The combination with a primary apron of a secondary apron made to operate transversely to the primary apron, a magnetised plate secured in proximity to said secondary apron, so as to draw the iron particles to said secondary apron, and means for adjusting the magnetised plate in relation to the secondary apron, substantially as set forth.

8596. "Improvements in automatic telegraphy." J. Y. JOHNSON. (Communicated from abroad by E. J. Mallett of New York.) Dated June 12. 1s. 1d. Is directed to simplifying and rendering more efficient the means for automatically stopping and starting the transmitter, and for effecting or controlling the feed of the car or holder which contains the prepared card. The claims are 11 in number.

9206. "Improvements in galvanic elements or batteries." C. LUTCKE and P. GEORGE. Dated June 23. 8d. Claims:—1. A galvanic element or battery with two fluids, in which a porous receiver and the electrodes are arranged in such a manner that the diffused, depolarising, disturbing fluid can fall into a free space below the active electrode surface and the porous cell in the fluid of the element, without being able to mingle with the fluid of the element in a way that would produce disturbance, substantially as hereinbefore described. 2. The adaptation of an overflow pipe to the porous vessel named in claim 1, by which the fluid accumulated through endosmose on the negative electrode falls into the lower space, as set forth. 3. The application of a second, smaller, negative electrode to the element, claim 1, as a secondary terminal in the lower space for the purpose of decomposing the disturbing sulphate of copper diffused towards the lower space.

9660. "Improvements in electric motors and dynamo machines." A. J. BOULT. (A communication from Orazio Lugo, of New York.) Dated July 3. 1s. 1d. Claim:—In an electric motor or dynamo machine a series of stationary electro-magnets, a series of revolving electro-magnets, one having an uneven number and the other an even number, the two series being arranged concentrically and parallel with each other, a stationary commutator to the segments of which, the coils of the fixed series are connected at one end, a common or multiple arc connection for the other ends of the coils of said series; a revolving brush for said commutator, a revolving commutator, to the segments of which the coils of the revolving series are connected at one end, a common connection for the other ends of the coils of said revolving series, and a stationary brush for said revolving commutator, whereby the current is directed through the coils of one stationary and one revolving electro-magnet, and the said electro-magnets form a closed magnetic circuit, this action taking place in proper sequence, so that each stationary electro-magnet makes a close magnetic circuit with each revolving electro-magnet once during each revolution.

CORRESPONDENCE.

The Pentane Standard Lamp.

In a kindly humorous leaderette last week you allude to the tests made by me with the Harcourt pentane lamp No. 2, and you would appear to exempt me from the category of "ordinary mortals" as regards photometric tests.

Will you kindly allow me to disclaim this honour and to explain to your readers how anyone with "ordinary" eyesight and proper precautions may attain equally accurate results with myself.

I think it is probable that few observers have had at their disposal such means of testing as I have enjoyed at the works of the Woodhouse and Rawson Electric Manufacturing Company. We have there an installation for photometric work in which no pains or expense have been spared to eliminate every possible source of error, and to give to photometry a much more important position as a science than it has hitherto enjoyed. Many important physical facts have been determined by its assistance which would otherwise have been unsuspected.

But it is principally by the employment of an electrically-produced source of light, coupled with the use of absolutely reliable incandescent lamps, that any delicate tests become at all possible. The delicacy of electrical instruments is well known, and is alluded to in my report, but without correspondingly reliable lamps and accumulators such work would have to be abandoned in disgust.

We have frequently attempted observations with other lamps than those of our own make, and have been obliged to discard them owing to their want of permanency. Work has had to be abandoned sometimes on account of some fluctuation in the cells that would never be suspected without the assistance of a delicate galvanometer.

Many interesting physiological facts bearing on what is generally called upon to explain away all photometrical eccentricities, and which is called the "personal equation," have come to light during the experiments. But with all possible care and practice it still remains impossible for observers to make *single observations* with anything approaching the degree of accuracy you mention. Such results can only be obtained by taking the mean of a series of readings, and the larger the number of readings the more likely is the result to be correct, *provided the conditions do not change* during the readings. If changes are taking place the theory of probabilities involved in the above method of working assists us very little, and it becomes necessary to examine the physical conditions. The time-honoured standard candle is a conspicuous instance of this, and its continuance as a standard under Parliamentary sanction has done more to retard the advance of photometrical science than any inherent difficulties of photometry itself. Your estimate of the average accuracy of photometric tests as being from 1 to 2 per cent. is probably not far from the mark, but this applies to single readings only, and should be interpreted thus:—That the ordinary difference between the highest and lowest readings in a series usually amounts to from 1 to 2 per cent. of the mean value obtained.

In the report of tests made by me I purposely gave a series of readings as a sample of the degree of accuracy generally obtained. This accuracy depends largely upon constant practice as is well known, but physiological conditions affect it to some extent.

In conclusion, I have only to repeat a sentence in the final paragraph of my report, that with the pentane lamp No. 2 "the constancy of results is probably greater than our present method of observation can accurately gauge."

W. Stepney Rawson.

October 24th, 1888.

Electric Cranes.

In the very interesting paper by Mr. W. Anderson, M. Inst. C.E., read before the British Association, there is an apparent discrepancy between the columns "watts at crane" and "horse-power at crane." The latter appears to have been calculated from the watts by the use of a constant = 846 approx., in all but the last test. The effect of this is to lower the actual H.P. by about 7½ per cent.

Supposing, however, the figures given for the H.P. absorbed to be correct, it shows that the tractive force required per ton for longitudinal travelling amounts to from 53 to 73 lbs., inclusive of losses.

Had a separate motor been used for this as well as for the other movements, the tractive force would, in all probability, have been reduced to an average of from 28 lbs. to 30 lbs. per ton, inclusive of all losses in the crane. This is about the figure required in the traveller at Messrs. Mather and Platt's, where each movement is worked distinctly from the others.

Hence I think that there is a decided advantage in this mode of working, as it takes less power and dispenses with complicated gearing and constantly running shafts.

W. L. Spence.

October 24th, 1888.

The London Chamber of Commerce—Electrical Trades Section.

Now that the result of the election of the Working Committee of the Electrical Trades Section is known, I should be glad if you would allow me, as one of those who have not yet joined, to make a few remarks.

I was invited by Mr. Crompton to attend a preliminary meeting on the subject held last July, but was unable to attend, and strain of work has hitherto prevented me from an opportunity of urging a different mode of election and constitution of the working committee.

The success of such a scheme as this must depend on the strength of the committee, and the feeling that it is an adequate representation of those supporting it. What brought about the present formation was a general feeling of its necessity among the trade, not the professional side of the electrical world at all, but

the manufacturers, the contractors, those who by able management and enterprise have been the means of establishing the numerous factories that will in the future enable England to take a foremost place everywhere for her electrical goods.

The telegraph companies, Goodness knows, have succeeded in the past well enough without any electrical section at the London Chamber of Commerce, so have the telephone companies, and it was not to meet the wants or demands of these corporate bodies that the present section was formed, or was ever likely to be proposed.

And yet what do we find on analysing the list of members and their representation on the committee. Telegraph companies, 14 memberships, 5 on the committee ; telephone companies, 9 memberships, 3 on the committee ; electricity supply companies, 16 memberships, 6 on the committee ; a representation in every case of one-third. For the electrical manufacturers and contractors, those on whom the success of the scheme depends, in fact, without whose support it must remain a dead letter, there is a representation of less than one-seventh, 94 memberships with 13 on the committee.

It must be apparent that this is wrong, and on increasing the committee up to the allotted 48 it should be borne in mind.

Now, as to the election of the committee ; could not this be improved on by the adoption of some such plan as Mr. Ritchie's scheme for the election of county councillors. Two-thirds of the committee to be elected by the enfranchised subscribers of their guinea, and one-third to be elected by the committee with a view to strengthening themselves by the addition of able and useful men in the electrical world.

This would be an admirable corrective to a ballot of this kind, and has many advantages.

The two-thirds of the committee to be balloted for should be principally drawn from the electrical manufacturers, who, as I have already demonstrated, must be the heart and soul of the thing, if it is to be any good. A further selection could then be made from gentlemen connected with the telegraph. telephone, and electricity supply companies (preferably officials than directors), from consulting engineers and others prominently connected with electrical matters, who express their willingness to give suitable time to the work. The selection could be varied every year, and the services of many might be secured who would not feel disposed to put themselves up for invidious distinctions by ballotting. The committee would thus have a useful power of obtaining the services of those whose knowledge, whether on technical matters, commercial subjects, or the ethics of fire risks, would be of service to them, and, at the same time, it would restrict the committee to those who are able and willing to attend.

It might be argued that this would lead to exclusiveness, and to the formation of a clique ; but with this I disagree. On carefully scrutinising the list of those already elected, it will be seen there are many who, from their very positions and their numerous important duties, will find it impossible to attend, and therefore the business will be left in the hands of the few, as in the other mode of election would not be the case.

On mentioning this I was told (of course, by an irresponsible person, so there is no need for an official disclaimer) : "All the better, then a few of us can work it."

Now, if there be one thing that will alienate the support of the electrical trade more than another, it would be a feeling that the committee is "worked" by a little family party. If it be borne in mind that many of the most prominent members will not attend for reasons before-mentioned, a careful and thoughtful scrutiny of the elected might show that such a feeling is not altogether without foundation.

I do not, however, believe there is any such intention, and such could be readily defeated if only all the members of the committee would attend.

I am pleased to see, at any rate, two of the electrical journals represented, who, in fact, should be *ex officio* members of the committee. As the means of disseminating all that is interesting and instructive to the trade, they constitute an enormous power, and it is important that they should be well in touch with everything that goes on, and identified with every movement of this kind.

The success of the present undertaking depends now on the working committee. I and many others who have not yet joined are awaiting events.

If it is to be the means of airing individual interests, of coercing master and man, or of interfering and generally busy-bodying with matters foreign to it, then it will drift for a time and sink away ; but if it can succeed in cementing and protecting trade interests, and diminishing trade burdens, it will have fulfilled a duty that, for my own part, I regret the Society of Telegraph-Engineers and Electricians, with its prestige and position, did not some time ago recognise and undertake.

John B. Verity.

October 29th, 1888.

Solder for Telegraph Line Wires.

Mr. Jamieson asks for some information about solder. The following information may be of use to your readers as well as to Mr. Jamieson.

Soldering is a term applied solely to the process of uniting the surfaces of metals. It is done by the intervention of a more fusible metal than that which has to be united. The soldering metal being melted upon each surface, serves partially by chemical affinity, and partially by the exertion of cohesive force, to bind them indissolubly together.

Solder is usually an alloy. It must not only be more fusible than the metal or metals to be joined, but it must have some chemical affinity for them, Hence different sorts of solder are employed for different purposes. It is called either hard or soft, according as its fusing point is high or low.

Thus there are :

1. Hard pewterer's ... 2 Bismuth ; 4 lead, 3 tin.
2. Soft „ ... 1 „ 1 „ 2 „
3. Hard plumber's ... ... 1 „ 2 „
4. Soft „ ... ... 3 „ 1 „
5. Hard spelter ... 12 zinc, 16 copper.
6. Soft „ ... Equal parts zinc and copper.
7. Telegraphic solder. Ingot tin and pig lead are taken in equal parts by weight, and melted together.

Hard spelter is used for copper and iron purposes, and soft spelter for brass work. There are also particular solders used for gold and silver work.

The test of efficiency of solder is a peculiar creaking sound, called the "cry of the tin," which is heard when a stick is bent close to the ear.

W. H. Preece.

G.P.O., London, *October 29th*, 1888.

Testing the Internal Resistance of a Secondary Battery.

With reference to Mr. J. D. Dallas's discovery of the method of measuring the internal resistance of batteries after reducing their electromotive force by opposition, you will find this mentioned in a discussion on batteries at the Society of Telegraph Engineers, 14th April, 1875, page 185. It was the method which I employed to measure the resistance of Clamond's thermopiles and Byrne's pneumatic battery. I have recently measured the internal resistance of 141 E.P.S. accumulators in series by this method, but I do not remember having ever seen it mentioned before the date of the discussion at the Society of Telegraph Engineers.

F. Higgins.

October 29th, 1888.

Nothing New Under the Sun.

In reading the highly interesting article entitled "Phenomena of magnetic propagation," by Prof. Elihu Thomson and Mr. Wightmann, contained in your

issue of October 26th, I find these authors referring to a new meter for alternating current work invented by Mr. Schallenberger, of Pittsburg, and described in your paper dated September 28th.

Will you allow me to state that some two years ago I constructed an apparatus to produce rotary motion by the application of an alternating current.

This apparatus, which I showed to some of my friends, is identical in form and principle with Schallenberger's current meter.

My idea was obtained from a similar apparatus invented by Messrs. Fonvielle and Lontin, of Paris in 1880, and called the "Electrical Tourniquet." This apparatus produces rotary motion by making and breaking of current.

A full description is given in your paper dated July 1st, 1880.

J. Ebel.

October 30th, 1888.

Lightning.

In the letter from Prof. Lodge, which appeared in your issue of October 19th, there was a passage I felt I ought to take some notice of, but I thought it better to allow a little time to elapse lest I should write in a somewhat unphilosophical condition of mind.

In my previous letter I quoted the actual words used by me in my late article, to which exception had been taken. I thought the doing so would show in the most unexceptionable manner I could think of that the sentence animadverted upon, did not deserve the construction put upon it.

I am generally too much in earnest to bandy compliments, and I feel it would be bad taste, not to say presumptuous, for me to do so in reference to Prof. Lodge, but under the circumstances I may be allowed, perhaps, to say I have been very much impressed indeed with the painstaking character of what published work of Prof. Lodge's I have read, and if I may give utterance to my real feelings I have been also impressed with what has appeared to me the very fair and more than usually honest way in which his experiments have been described. I am certainly indebted to him for rousing me out of my sleep, for making me collect my thoughts, and causing me to look up some rather old notes.

My object in now writing is chiefly to relieve my mind of a few thoughts which bear more or less on the subject of the controversy.

I am glad to find the views I have arrived at in reference to the source of electric oscillations harmonise generally with those entertained by Prof. Lodge. Weight and inertia are related, they seem to me to be convertible terms, and they are certainly leading characteristics of matter, but my present condition of mind is that I seem to know just enough to be able to realise that I know next to nothing of the nature of matter, and to make me waver also on some of the largely accepted articles of scientific faith.

In my late article I have ventured to suggest that matter in motion is a combination of energy or external force with matter, and that inertia is the storage of such energy, and represents, in a sense, its storage capacity, resembling in this respect the sectional area of a conductor to electricity of any given potential.

Time is concerned in the absorption of energy by matter, time also is involved in its dissipation, and when one form of energy becomes translated into another, then time seems to me to be the link which connects and determines in a great degree the particular protean shape into which the energy becomes resolved.

As an illustration, take a glass ball and cause it to fall from a moderate height on to a large mass of glass, and let it be assumed that the space through which it falls is a vacuous one.

The glass ball commences its descent with energy of position only, but energy becomes stored up or imparted to it during the descent, such imparted energy relatively to the weight of the ball being directly as the time gravity has been acting upon it.

On reaching the surface of the mass of glass the ball will rebound to nearly the same height as that from which it started, and if it be arrested at the top of its re-ascent it will be found to have recovered nearly the whole of its original energy of position.

In the example just given, if we overlook a small percentage dissipated as heat, there is no conversion of energy whatever.

The energy imparted by gravity to the ball, and which produced motion, becomes dissipated in motion, resisting gravity, and the interval of time consumed during the rebound is exactly the same as that which was consumed during the descent, overlooking, of course, the small percentage of heat produced, and which reduces, slightly, both the height and the time occupied in the rebound.

Substitute an agate ball for the glass one, and let it fall from a much greater height; the agate ball will not now rebound like the glass one did; instead of doing so it will overcome the cohesive force of the glass, crush it into dust, and penetrate into the mass.

In this second example there will be a considerable conversion of energy, and this conversion will be effected in very much less time than that which was taken by gravity in imparting the energy stored up in the ball.

From the observation that time is an important element whenever one form of energy is translated into another form, I venture to go a stage farther.

We know magnetism possesses inertia, and resistance is opposed as a consequence to the sudden magnetisation of a mass of iron much in the same way as resistance is opposed by matter to a sudden transition from a condition of rest to that of rapid motion, and therefore I suggest that the transmission of energy from a local source to a distance by means of the dynamo (and which, as far as I know, has never been attempted to be explained) becomes possible, because as the energy developed in the steam engine and imparted to matter in the form of motion is irresistible, it must force an outlet for itself somewhere; and when it encounters magnetic inertia, it becomes as a consequence deflected, but not like the glass ball illustration, which simply rebounded. Instead of rebounding, the energy obtains a channel for itself through the insulated wire of the revolving bobbins in the shape of electric motion. The electricity (whatever this may be) set in motion is determined by the sectional area and other conditions of the conductor, but not so the energy, which is indestructible. Therefore when the conditions are such that the quantity of electricity available to be set in motion is small, the energy becomes concentrated and is developed at a correspondingly high potential, and the reverse of this occurs when the channel which in the electric motion is set up is one of large capacity.

Let us return now to the glass ball illustration; if it be dropped and allowed to rebound, it will continue to do so for some time, the amplitude of each successive rebound being less than the preceding one, and eventually it will come to a state of rest. Here, I think, we have a very fair analysis of the cause of oscillation, which is produced by a storage of energy in matter, which must be dissipated in some way, and which involves time in doing so. Professor Lodge says electric oscillation involves inertia. Here I am in agreement with him, but I have tried to go a stage farther, and have attempted an analysis of inertia. I come to the conclusion that inertia may be regarded as a storage of energy, and that electric oscillations are produced by magnetic inertia, the existence of which is not disputed. Professor Lodge, I should gather, attributes electric oscillations in a lightning conductor to electric inertia. Now I do not say there is no such a thing as electric inertia; but all I say is I have not yet come across evidence which convinces me of its existence.

There are many other thoughts crowding in upon me which I should like to refer to, but this letter has already run out to such a length, that I must defer them for a time.

S. Alfred Varley.